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STATE INSPECTOR OF MINES,

APPOINTED UNDER THE ACT OF THE GENERAL ASSEMBLY
TO REGULATE MINES AND MINING, PASSED
MARCH 21, 1874,

TO THE

GOVERNOR OF THE STATE OF OHIO,

FOR THE YEAR 1874.

COLUMBUS:
NEVINS & MYERS, STATE PRINTERS.
1875.

FIRST ANNUAL REPORT

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ANNUAL REPORT.

COLUMBUS, OHIO, *December* 1, 1874.

To His Excellency WM. ALLEN, *Governor of Ohio:*

SIR: In compliance with the requirements of the act of the General Assembly entitled "An act to regulate mines and mining, and to repeal an act therein named," under which act your Excellency conferred upon me the honor of appointment as State Inspector of Mines, I herewith submit my first annual report of the condition and operations of the coal mines of the State, together with such other matters and information in connection with mines and mining as I have deemed of importance. At the end of the report I have made a tabulated statement of the number of mines in the State, giving the name of each, the county where located, and the name and post-office address of the firm or company operating the same. On or before the 31st of December I shall send out circulars to every operator in the State, requesting information in regard to the number of men and boys employed under ground and above ground, and also as to the amount of coal mined for the years 1872, 1873, and 1874; and if this information is returned before the report goes into the hands of the printer, I shall add it to the tabulated statement referred to.

I have also tabulated the number and causes of deaths and serious accidents to date, as far as reported, and shall add to the list as returns reach me. The number of fatal accidents reported to date are twenty-four, and the number of serious accidents eighty, but they have not been as fully reported as they should have been. The following are the names and causes of fatal accidents to date:

January 5. A boy (name not given) fell down the Silver Creek shaft and was killed.

January 26. Isaac Martin was killed at the Furnace Company's mine by a fall of slate.

February 15. Baer Shelby lost his life by a fall of rock at the mine of the Cambridge Coal and Coke Company.

February 23. James Davison was killed by a fall of slate at Shawnee, in the mines of the Newark Coal Company.

March 19. Wm. Howard, a driver, was killed by being kicked by a mule at Washingtonville slope.

April 18. Robert Dallas was killed by a fall of roof at the Stewart mine, in the Mahoning valley.

June 20. Robert Cundiff lost his life by the premature explosion of a blast at Syracuse slope.

July 17. Francis King was fatally injured while drawing pillars at Hanging Rock.

August 10. Frank Moore was killed in Highland mine by a fall of slate.

August 10. Wm. Wolf was killed at the Haydenville mines by a fall of coal.

A boy was also killed at these mines, above ground, by being run over by the cars. Name and date not reported.

September 10. E. Pickering was killed in Brooks' mine, at Nelsonville, by a fall of coal.

September 16. Wm. Saterfield was killed in the same mine by a fall of slate.

September 11. Francis Davis was killed on the dump at Shawnee (Newark Coal Company), by being struck with a piece of iron thrown by a laborer on top.

September 25. John Fisher was killed while standing in the bottom of the Aberdare shaft, near Massillon, by a piece of coal falling down. The cage had no cover, and the accident was done in violation of the law.

October 12. George Longly was killed in Brooks' mines, at Nelsonville, by a fall of coal.

November 1. A man was fatally injured at the Silver Creek mines, by a fall of slate. His name was not reported.

November 6. Joseph Vintus was killed at Longstreth's mines by a fall of coal.

November 9. Wm. Wilson was fatally injured by a fall of slate at Chippawa mines. His back was broken, and he lived for some weeks after the accident.

November 16. Joseph Berg fell down the shaft at Grove mine, near Massillon. The shaft had no safety-gates, and the accident was caused by their not being provided as the law required.

November 20. James Moore and Joseph Norman were killed at the Maple Grove mine by the bursting of the boiler.

November 24. Mrs. Huber, an old lady, was run over on the tram-road, while picking up coal at the Aberdare mine.

November 26. George Fudge was killed at Mineral Ridge, in the Ashland slope, by a fall of roof.

*December 24. John Price was killed in Kyle shaft, Mahoning valley, by premature blast.

*December 30. August Carraba lost his life in Church Hill slope by a fall of slate.

*December 31. Michael Welsh was killed in Wadsworth slope by a fall of slate.

Of the serious accidents reported, twenty-four had limbs broken, besides other serious injuries sustained. Two men had their backs broken, but are still living; one man had both eyes blown out, besides sustaining other very serious injuries; one man had a leg taken off, and one lost an eye. A number of those seriously injured will never be able to work

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*Added since this report was written.

again, and have large families, who are thus deprived of their main stay for support.

A number of accidents were doubtless never reported at all. Few, indeed, of either fatal or serious accidents were reported by the persons having charge of the mines; they were mainly collected by myself while visiting the mines. The majority of these accidents were due to the perils of the mine. Their number can be reduced, by greater care and attention, and by an increase of knowledge of danger. Quite a number of the more serious, and some of those of a fatal character, were the result of a want of all knowledge of mining, the parties having gone to work for the first time during the prevalence of a strike.

This alarming list of accidents suggests the establishment of some benefit fund for the assistance of the widows and orphans, and the families of helpless miners. After the Avondale catastrophe in Pennsylvania, the employes of the Lehigh and Wilkesbarre Coal Company established a benefit fund, the movement being due to the inspirations of the company, who gave the whole yield of their works for one day, the miners also giving a days' labor for the relief of the sufferers of that calamity and the establishment of a permanent fund. The amount raised was $6,000, and since then the fund has been rapidly accumulating, each miner giving a days' work before being admitted as a member. The amount paid in from 1869 to 1874 has been $66,559. The amount paid out for benefits, the result of accidents, injuries, and deaths in the mines, has been $41,336, leaving a balance in the treasury of $25,223. Four hundred persons, who had sustained personal injuries in the mines, have been aided, and a number of deaths have occurred in the interval, the widows and orphans receiving aid for a certain time, and monthly payments being made to miners during the time they were laid up by wounds. The establishment of some such a fund is greatly needed in Ohio, and it is hoped some of the more liberal of the mining operators will take the matter in charge.

PREVIOUS LEGISLATION.

In the fall of 1871 the coal miners of the State--alarmed by the terrible catastrophe of the Avondale mine, in the anthracite region of Pennsylvania, by which the whole force of the mine, to the number of one hundred and nine souls, perished for want of a second outlet—held meetings, and signed petitions to the Legislature, praying for the enactment of a law to regulate and ventilate mines, and for authorized official supervision by the State.

The petitions were presented to the Senate by Senator Woodworth, of

Mahoning county, and were referred to a select committee of seven Senators from the mining regions of the State. This committee authorized Senator Daugherty to prepare a bill on the subject. Mr. Daugherty's bill provided for the appointment of two State inspectors—the State to be divided into two districts. Six of the seven Senators recommended the passage of the bill; but it met persistent opposition from the operators of the mines, who regarded it as an unnecessary and unwarranted species of legislation.

Senator Woodworth thereupon introduced a joint resolution in the Senate, authorizing the Governor to appoint a commisssion of three competent persons, one or more of whom should be practical miners, to inspect the leading coal mines of the State as to ventilation, means of ingress and egress, and as to all other matters affecting the lives and health of miners; and also to inquire into the causes of strikes, and report to the Governor, for the use of the Legislature, the facts found in the premises—recommending such legislation as in the judgment of the commission the facts might demand.

Governor Hayes appointed Messrs. Charles Reemelin, of Cincinnati, B. F. Skinner, of Pomeroy, and the writer, members of this Board. It was on duty four months. The report of the commissioners was laid before the Legislature in the following January. Senator Jones, of Trumbull county, chairman of the committee of Mines and Mining in the Senate introduced a bill for the ventilation and inspection of mines at this session, which, although passing the Senate by a unanimous vote, failed to secure a constitutional majority in the House, and a substitute, by Mr. Conrad, of Portage county, was made a law. This substitute included all the provisions of the Senate bill, except as to official supervision of the mines by the State. As it failed to provide for inspection—its precepts and provisions were disregarded by nearly every mine-owner in the State—Governor Noyes accordingly, in his next annual message to the Legislature, called attention to its defects, and urged the Legislature to so amend the law as to provide for authorized official supervision; otherwise it would continue to be for the most part inoperative. Mr. Sterling, of the House, introduced a bill supplementary to and amendatory of the law, as enacted, providing for a State inspector of mines, and prescribing his duties; but it failed to become a law.

During the early part of the last session of the Legislature, however, two bills were introduced in the House of Bepresentatives for the inspection of mines—one by Mr. McLain, of Trumbull county, and one by Mr. Baker, of Perry county. Mr. McLain's bill was amendatory to the act in force, and had the same object in view as Mr. Baker's, but the Baker bill, containing the whole act, was adopted in committee as being simpler than the other, and it became the law of the State.

The enactment of such a law was the result of wise and prudent statesmanship, and is due to the necessities of mining. Mining is a business subject to special and varying dangers, whose operations are far removed from the reach of public vigilance and investigation. No other class of workmen are so dependent upon employers as miners. The engineer, machinery, ropes, ladders, etc., by which the miner descends to his work and returns from it after the toils of the day are ended, are furnished by the employer; the passage-way of the mine to his subterranean workshop, the props for the support of the roof, and the ventilation—the air of heaven itself—are beyond his control, subject only to the will of the operator or his responsible manager. In the murky chamber of the coal mine, where God's sunlight can never come, mephitic and inflammable airs abound; dangers from falling materials in the mine and in the passages of the mine, and dangers from water, confront the miner. Hence the necessity of authorized official supervision, to see that all approved safeguards are provided to protect the health, lives, and safety of miners, has been recognized by every coal-producing country. Great Britain, France, Belgium, Germany, and other countries of the Old World; the British American colonies, and Pennsylvania, Ohio and Illinois, of the New World, have each their mining codes for the protection of their underground workers, and their mine inspectors to see that the laws are enforced and obeyed.

All practical mining experience goes to show that the enforcement of such laws confer benefits to both parties in interest—the operator of the mine equally with the working miner. It is to the interest of operators to ventilate well, for miners do more work in good air than in bad air; yet many operators, or their responsible managers, regard the construction of ventilating shafts and air-ways, and other arrangements of this character, as evils to be shunned to the last hour. All safety appliances having for their object the protection of the miner protect property at the same time; the breaking of a rope in a shaft smashes the cars to pieces, where no safety-catches are provided, as well as kills men; the presence of safety-gates on top of shafts saves more cars from falling down than men from falling down. And no mine ought to be worked without being properly surveyed and mapped at proper intervals; especially is this true of a mine approaching abandoned workings filled with water or mephitic gases, or inflammable airs. The application of the statute of last winter to mines and mining is simply the application of enlarged mining experience.

I commenced the work of examining mines on the 7th of April, my commission bearing date of the 6th, and have been constantly employed in this duty ever since, except during the time given to office work. I have visited and inspected upwards of two hundred mines, many of them twice, and, in a few cases, three times. I take pleasure in stating that, while fulfilling my duty in this respect, I have received from the mine superintendents and operators the greatest courtesy and assistance; and in visiting mines which were skillfully managed and well ventilated my visits were always very welcome. In numerous instances also, where bad management prevailed, including defective arrangements for ventilation, the bosses have felt anxious to have pointed out more approved modes of mining.

The chief complaint of the miners was the presence of bad air in their working places. They regard the ventilating sections of the law as the very life of the act, and speak of it as the "ventilation act." They cared little for other proposed improvements, but demanded that there should be better air provided; and their grounds of complaint were as well founded as they were numerous. Any person who considers the necessity for ventilation in the case of public and even private buildings, will at once comprehend in what condition the atmosphere of a badly ventilated mine must be, with its pent up air, charged with noxious and poisonous vapors, and reeking with the exhalations of the workmen's bodies and lungs, and the smoke from their lamps, and frequently with blinding volumes of powder smoke, besides innumerable particles of coal dust, held by mechanical suspension in the air.

Many of the provisions of the law did not go into effect for six months after its passage, and the requirement of two openings to mines gave twelve months, where fifteen thousand square yards had been cut. The provisions which apply to ventilation gave till the 21st of September to improve the air arrangements. In my examinations during those months I made careful inspections as to the condition of the air, and in many mines measured the amount of air which entered the mine, which I found very frequently to be far too small. I took plenty of time with the most of mines, studying the system of ventilation in practice, examining the construction of furnace or other ventilating forces. Since I commenced the work of inspection I have traveled upwards of eight hundred miles on foot under ground. As the result of my investigations, I have seen nothing in the condition of mines to make ventilation difficult, and there is no excuse whatever for the presence of bad air. It is purely a result of bad management. All the arrangements in use, except where exhaust steam was applied to rarify the air of mines, had they been timely and properly constructed, could have been made to answer every requirement of the law.

THE NOXIOUS AND POISONOUS GASES OF COAL MINES.

Proto-carbureted hydrogen gas, or light carbureted hydrogen gas, the fire-damp of coal mines, consists of one volume of the vapors of carbon and two volumes of hydrogen, condensed by affinity into one volume. Its specific gravity is .562, atmospheric air being as 1. Being lighter than common air by nearly one-half, it occupies the roof and highest places in the mines. It is emitted from the fissures and minute pores of the coal, and exists in a highly compressed state. It is generally found in greater abundance near dykes and faults in the coal, and is more copiously evolved from coal of a highly coking character than from open, dry-burning coals. It was doubtless generated during the process of the decomposition of the carbonaceous matter which forms the principal part of the coal, and from the hydrogen from the decomposed water and moisture.

Mines which are shallow seldom give off explosive gas in any alarming quantities, it having no doubt found means of escape to the surface through the crevices by which the water is let in on the coal. As the fire-damp exists in a highly compressed state, being pent up by the counterpoising pressure of the atmosphere, any lightening of atmospheric pressure, as indicated by a fall of the barometer, is a sure presage of an extra discharge of gas. Fire-damp is not explosive until it is mixed with five times in volume of common air, and then the explosion is very feeble. It also ceases to be explosive when fourteen times its bulk of air is added to it—nine and one-tenth times the volume of air to one of the fire-damp forming the most powerful explosive mixture. In this condition the instant a naked light is placed amongst it, it explodes with the rapidity and violence of powder, and produces the most fearful consequences.

The presence of fire-damp in mines is ascertained by means of the safety-lamp of Sir Humphrey Davy, or some other modification of it. These lamps are all covered by a cylinder or cage of iron wire gauze containing seven hundred and twenty-eight appertures to the square inch. When a safety-lamp is brought in contact with fire-damp, the gas will explode inside of the lamp, but the gas outside will not ignite, even though the wires of the gauze cylinder be red-hot, because the wires cool the burning flame sufficiently to prevent it from setting fire to the inflammable air outside. A current of air moving at the rate of seven feet per second will drive the flame of a safety-lamp through the wires, and will cause an explosion if the air be sufficiently charged with fire-damp.

The products of an explosion of fire-damp contains seventy-one parts of free nitrogen, nine and one-half parts of carbonic acid gas, and nineteen parts of steam, forming a most deadly gas, by which more men are destroyed than by the inflammable air.

Black-damp (carbonic acid gas) is composed of two gases, carbon and oxygen, in the relation of 27.27 per cent. of carbon and 72.73 per cent. of oxygen. Its specific gravity, as compared with common air, is 1.524. It readily diffuses itself among the atmospheric air; but when it accumulates in a solid stratum it lies upon the floor of the mine, sometimes occupying one and two feet of thickness. It is produced in coal mines from a number of causes which are in constant operation—by human respiration, the combustion of the workmen's lamps, explosions of gunpowder, the excrementatious deposits of men and animals, the decomposition of timber, and the slack of the gob-wastes, and it is frequently liberated from the coal. In some mines it is evolved so rapidly from the fissures of the new-cut coal face as to extinguish the workman's lamp when presented before it.

This gas was formerly called fixed air by its discoverer, Dr. Black, of Edinburgh, from its existing so copiously in limestone and other solid substances.

White-damp (carbonic oxide) is also composed of carbon and oxygen, containing 56.69 per cent. of oxygen and 43.31 of carbon. It is a little lighter than atmospheric air, being as .975 to 1. This gas is very deleterious in its nature, and, unlike the black-damp, which will not support light in a deleterious atmosphere, the workman's lamp burns with great clearness in a most deadly atmosphere of white-damp. This gas is seldom met with in coal mines from natural causes, and is produced mainly from explosions of blasting powder and from fires. In ancient times, when fires were used in mines to render the rocks brittle, the white-damp was a deadly foe to the miner. Agricola, a German mining writer, whose works were published in the year 1556, tells us that the miners of his day would frequently fall back from the ladder in climbing up the shaft, after the toils of the day, overcome by the deadly influence of the white-damp. The miners who were lost by the Hartley disaster, in England, thirteen years ago, numbering two hundred and four souls, as also those who were involved in the catastrophe of the Avondale shaft, in Pennsylvania, one hundred and nine in number, were destroyed by this gas, given off by the furnace.

In mines in which powder is copiously used to throw down the coal the workmen often suffer from the presence of the white damp. Gunpowder contains 74.8 per cent. of saltpetre, 13.3 per cent. of sulphur, and 11.9 per cent. of charcoal, which is converted by explosion into 66 of carbonic acid, 14 of nitrogen, and 55 of the sulphate of kalium, equivalent to 50 per cent of carbonic oxide. The effects of breathing an atmosphere changed with the products of an explosion of gunpowder are headaches, difficult breathing, and latterly insensibility, the miner dropping over as if he were dead.

Another inmate of the coal mine, sulphureted hydrogen, sometimes called white-damp by the miners, is generated in the wastes which are shut off from the reach of the ventilating currents of air. It is formed from the decomposition of pyrites of iron with which the coal is often impregnated. This gas has a very unpleasant smell, resembling rotten eggs, and produces fainting, giddiness, and asphyxia. It is composed of 94.15 of sulphur and 5.85 per cent. of hydrogen, and is a little heavier than atmospheric air. The miner's lamp will burn among a mixture of this gas where human life cannot exist.

The gases enumerated above become dangerous and fatal elements only where the ventilation is neglected; but where timely and elaborate arrangements are applied for the production and maintenance of an abundance of fresh air to sweep them away as fast as they are generated, the subterranean workshops of the miners are safe, healthy, and pleasant, and the miners never complain of their presence.

In connection with the injurious effects of imperfectly ventilated mines, the following statements are submitted:

John Hutchinson, Esq., M.D., an English physician of eminence, in a communication to a committee of the House of Lords, appointed to inquire into the best means of preventing the recurrence of dangerous accidents in coal mines, in the year 1848, said:

> Although a miner's occupation could not be considered as destructive to health, yet certainly it is not a healthy occupation, and, perhaps, the diseases may be confined almost entirely to the lungs or to the respiratory organs in general (the heart and lungs). At a distance you may know a pit man by his high shoulders and stooping back; at hand you may know him by his blanched look and wrinkled and bloodless face—the appearance of age in youth. These symptoms are to be attributed to the deleterious quality of the air he breathes, an atmosphere densely and mechanically charged with carbonaceous matter. Upon the surface of the earth deteriorated air immediately ascends from the person and passes off forever. Were this not the case man would perish for the want of a respirable atmosphere. In the mines this is not the case; the air has to circulate and bend its tortuous course from one lamp, horse, and man to another lamp, horse, and man, and thus supply, probably, one hundred

> and fifty men, two hundred lights, and thirty horses and mules, before it returns to pass off into the general atmosphere. The miner works many hours, even all his time, in a kind of *cul de sac*, without a sweeping current of air playing immediately around him; his ambient air is nearly stagnant to all his feelings. This air is densely charged with coal dust, dust in its most palatable form, and his face becomes coated with it; the laborious work of hewing (striking the hard coal with the pick) excites, like other violent exercises, a great respiratory action. He breathes deep and draws into his lungs with avidity this loaded mixture. He breathes thick, and he is subject to asthma. If he has a consumptive taint he speedily falls a victim to disease; but should he be so fortunate as not to have any claim to this disease, his breathing is rarely natural, that is, inaudable. His blood is not aerated, and thus he presents the appearance already described—a man with a pale face. His conformation is thin, because his nutrition is impeded. The appetite may be good, yet the nourishment is deficient.
>
> In this close and dirty hole the miner labors and breathes a double quantity of air, therefore in his ten or twelve hours working respiration becomes equal to double that time of ordinary breathing when in a quiescent state. The effects of such an atmosphere are insiduous; gradually he becomes disordered in his breathing, and he is a victim to some chest affection before he is aware of it. Ultimately his lungs are loaded with black matter, solid or fluid, like printers' ink, or common ink, or lampblack, or charcoal powder—all insoluble and tasteless.

J. Kenyon Blackwell, Esq., appointed by Sir George Grey in 1849 to inspect the leading coal mines of England as to their conditions and manner of working, and as to all other matters affecting the lives and health of the miners, in his report, speaking of the deleterious effects of imperfect ventilation, says:

> There is another class of injuries, resulting from defective ventilation, to which miners are exposed. The circumstances producing these injuries are slow in operation, and as their effects bring disease, and not immediate and sudden death, their existence has been little considered. A careful examination of the state of mines leads to the conclusion that the ultimate loss of life is greater from this cause than even from explosions.
>
> These effects are the result of an inadequate supply of air, which has become vitiated and unfit for breathing, on account of its having lost its due proportion of oxygen, which is replaced by the formation of carbonic acid. This gas has its sources from respiration, the lights of the mine, the decomposition of small coal in the goaves, and of timber in the workings. Air in this state is also usually found to be loaded with carbureted hydrogen, yielded from the whole coal, or in the goaves. Sulphureted hydrogen; arising from the decomposition of pyrites, is sometimes present, especially in coal seams liable to spontaneous ignition. The gases formed by blasting are also allowed to load the air of mines to a very injurious degree.
>
> This state of the atmosphere of mines arises from the want of the necessary airways and other arrangements to discharge such portions of the air in circulation as may have acquired this condition, and to afford a fresh and pure supply at any part of the workings.

Those districts and seams of coal least affected by inflammable gas are generally those in which the ventilation is allowed to be in this imperfect and injurious state, on account of attention not having been called so imperiously to the subject as it is by the violent catastrophes resulting from explosions.

Asthmatic diseases, at an early period of life, are the unfailing results of ventilation which is deficient in quantity.

T. E. Forster, Esq., Inspector of Mines, in an examination before a royal commission appointed to inquire into the condition of mines in 1864, gives the following testimony in answer to questions:

In the collieries that I alluded to as being badly ventilated they had no inflammable gas, and that was the reason they were not well ventilated. Although you sometimes kill a few men by an explosion, these collieries where they have no inflammable gas kill the men by inches. There are quite as many, in my opinion, killed where there is nothing but carbonic acid gas as where there is inflammable gas. The men's health is naturally destroyed, and they kill them by inches. They do not go immediately, but they go on for a few years and die.

Question: Then where there is no fear of explosion there comes great carelessness with regard to the ventilation? Answer: They won't make the return air-ways sufficiently large to get the necessary quantity of air in, and that is the long and the short of it.

Question: Now, in your opinion, wouid it be more difficult to ventilate those mines where there is no inflammable gas than to ventilate those mines where there is? Answer: I think it is very likely that the mines where there is no inflammable gas, they being shallower mines, are a little more difficult to ventilate than deep mines where there is a little inflammable gas; there is no power; they have not the depth of shaft.

Question: Do you think the depth of the shaft facilitates the means of ventilation? Answer: It gives a greater power; there is no doubt of it.

As the requirements of the law in regard to the amount of ventilation have been considered by many mining operators and others as too high, I submit a few extracts from the testimony of the best practical minds on the subject.

Prof. Philips states that in most of the English mines which yield fire-damp abundantly, six hundred cubic feet of air per minute for each miner is circulated, and two hundred cubic feet in addition for each acre of waste.

Mr. Blackwell, in his report on ventilation, says that from two hundred and fifty to five hundred cubic feet per man per minute ought to be circulated, according to the requirements of the mine.

Mr. Hedley, Inspector of Mines, says that in practice he moved from one hundred to five hundred cubic feet per minute for each collier.

Mr. Taylor, Mining Viewer, says: "In a mine which yields no fire-damp, with one hundred and twenty to one hundred and thirty persons employed in it, I should think that a currrent of twenty thousand to thirty thousand feet per minute might be a fair quantity, if properly conveyed up to the faces of the workings, and made to sweep those districts where the people are employed; but in fiery mines I should require very much more than the quantity named."

Mr. Mackworth, Inspector of Mines, says: "After having examined and measured the ventilation in a great number of mines, I have found that where there is no escape of fire-damp, and little of any other mineral gas, one hundred cubic feet per minute for each man and boy was the minimum quantity of air essential for sanitary purposes alone."

Mr. Smyth, Inspector of Government Mines, in his recent work on coal and coal mining, says: "In round numbers, one hundred cubic feet of air per minute may be required for the health and comfort of each person underground, or for one hundred men, ten thousand cubic feet; but if fire-damp be given off—say at the rate of two hundred cubic feet per minute—we would need, at the very least, thirty times that amount of two hundred feet in addition of fresh air to dilute it."

Mr. Dunn, Inspector of Mines, says: "I should say that the minimum quantity of air for the most harmless of pits ought to be from ten thousand to fifteen thousand cubic feet per minute."

The following quantities of air, of cubic feet per minute, are sent through the mines named, in England:

Speedwell	Colliery	42,000
Malstig	"	46,000
Lund Hill	"	50,000
Shamrock	"	54,000
Sutton Heath	"	70,000
Gyfullem	"	70,000
Ardley Main	"	80,000
Ryhope	"	84,000
Seaton	"	100,000
Hurton	"	100,009
Wallsend	"	120,000
Hetton	"	180,000
Haswell	"	190,000
Usworth	"	200,000

It is a mistaken view to assume, as many do, that because a mine gives off no fire-damp there is comparatively little danger to human life. A careful examination of the reports of the British Mine Inspectors—British mines being more destructive to human life by explosions of fire-damp than all others in the world besides—shows that not more than one-sixth of mining casualties are due to explosions. Writing on this matter in his annual report, Mr. Lionel Brough, the ablest of the inspectors, says:

> The reigning cause of the destruction of human life is, unquestionably, to be found in the constantly recurring falls of stone and coal from overhead, and from the sides of working-places and traveling-ways. Fire-damp, though in itself most fearful, can not for a moment be put in competition with the immense amount of fatality consequent on falls of material underground. Explosion is, so to speak, comparatively rare in its dread occurrence; whereas, taking England, Wales, and Scotland throughout, not a single day may be said to pass without some calamity or other from the never-ceasing fall of ponderous masses of coal, or shale, or rock, or ironstone. In a moment life is crushed out, or bones are broken, and smashed in such a manner as to prevent the miner from all future pursuit of his calling.

I have copied at large from British mining authorities, in order to place the dangers of mining and defective ventilation in their proper light; for a very general feeling prevails among operators of mines, and the general public as well, that mines which yield no fire-damp are not dangerous to life and health at all. I apprehend that all the trouble I am likely to encounter in having the law enforced or obeyed will arise from neglect to provide and distribute the air of mines as the law directs, so as to have them in a fit state for men to work. Heretofore the complaints of miners of bad air have been set down as their whims, as worthy of no regard, or have been considered as sufficient cause, in many places, for the discharge of those complaining. I regard the provisions of the law in respect to ventilation as the very soul of the law, whose enforcement will do more to restore peace and conciliation in the minds of the miners towards the operators of the mines than anything else in the world. Of all classes of working men there is no fiercer spirit of hatred and retaliation against their employers found than among miners, and the existence of that spirit is due no doubt, in great part, to the influence of bad air of mines. You may preach the virtue of quiet and patient suffering to a person having a raging tooth-ache; but until the offending tooth has been extracted, or the pain has ceased to trouble, philosophy will be of little avail. So may you preach to miners of the relations of capital and labor; that the interests of both are identical; that both draw nourishment from the same breast; that the law of supply and demand regulates the price of labor; but to a man whose bones ache, and whose temper is soured from breathing the foul atmosphere of a mine, he sees his employer only as a tyrant, against whom it is a necessity and a virtue to organize and strike.

Plenty of fresh air will lessen the cost of mining, for men dig more coal in good air than in foul air; even the mules can do more work if the hygienic state of the mine be good. There is nothing to be gained by carelessness and neglect; and if operators of mines and mine superintendents, instead of cursing the folly and fatuity of the miners, will candidly inquire into the cause of complaint, they will find the policy of asphyxiating the miners takes money out of their pockets in other ways besides lying at the foundation of the numerous strikes. Mr. Mackworth, Inspector of Mines, says that by actual experiment made by himself in a number of mines which yielded fire-damp, and were well ventilated, and an equal number of mines which gave off none of this gas, where bad ventilation was permitted, it was found that each miner, as well as the aggregate of the miners, put out a good deal more coal in the fiery mines than in the unfiery ones; and this result was found in the fact that those miners who worked among poor air, although working as regularly and as long hours as the others where the air was good, could not perform the same amount of work. I have myself seen this fact demonstrated in a large number of mines. Time is lost picking your wick; you are enveloped in a cloud of smoke nearly all day; you have to get out to the air-course for a draft of fresh air, several times in the day; and your bones ache, your head aches—there is not energy to do the work.

THE PRINCIPLES AND APPLIANCES OF MINE VENTILATION.

Atmospheric air is composed of two gases, oxygen and nitrogen, with the addition of a small but variable proportion of carbonic acid gas; but the carbonic acid is not necessarily a constituent of the air, and is seldom found exceeding 1.2500 part of the whole. There are also present more or less aqueous vapor and ammonia, which are diffused throughout the oxygen and nitrogen, of which no account is taken in any chemical analysis. The composition of the atmosphere is 23 per cent. of oxygen and 77 per cent. of nitrogen by weight, or 21 per cent. of the former and 79 per cent. of the latter by volume. Oxygen is the most abundant substance in nature, forming, besides its proportions of the atmosphere, 89 per cent. of water and fully 33 per cent. of the solid matter which composes the earth. This gas is the constituent of the air upon which every form of light and life and all organic substances are dependent for existence. Nitrogen can neither support life or light, and cannot even be breathed in the lungs until it is diluted with oxygen. Neither of these gases have taste, color, or smell.

The air is a vast aerial ocean of which the earth is the bottom. It extends upward to a height of about forty-five miles, growing thinner and more elastic in the ascending column. The bottom of the column is pressed by the weight of the air from the top which squeezes it, contracting it into smaller bulk and consequently into greater density. At the height of three and one-half miles above the level of the ocean the air is twice as light and elastic as at its level; at seven miles of height it is four times as light, and so on in like proportion till it ceases to exist. A column of air the whole height of the atmospheric sea will weigh nearly a tun to the foot square—a column of one inch square weighing 14.7 pounds. This weight is called the pressure of the atmosphere, and this pressure is in all directions—upwards, downwards, sideways, diagonally, etc.

Air, in common with all gaseous bodies, is possessed of the properties of *inertia*, which means that it will not move when in a state of rest until force is applied to start it and keep it in motion. When the pressure is lessened on any side, the pressure on the opposite side pushes it forward in the direction of the place where the pressure has been removed. The movement of air in mines for the purposes of ventilation is produced by the application of force to increase or lessen this pressure at certain points. The powers applied are sometimes by a waterfall in a shaft, whose weight added to the weight of the air forces it forward; sometimes by a fan, which acts on the same principle, if it blows air downwards, but diminishes the weight if it exhausts the air; and sometimes by rarefaction induced by fire, or the application of steam in the state of exhaustion.

The unassisted forces of nature, in cases where the atmosphere of the mines and that on the surface of the earth are of different densities, are often found sufficient to move an adequate supply of air through the various ramifications of a mine.

The favorite motive powers applied to produce a circulating current of air in mines are by the furnace and the exhaust fan. Steam jets were proposed by Sir Goldsworthy Guerney, in the year 1848, and for a number of years afterwards this method was in high favor, as it avoided the danger in fiery mines of an explosion of fire-damp by the foul return currents in passing over the furnace; but after an elaborate series of experiments instituted by some of the foremost mining engineers of Great Britain, it was found to be greatly inferior to the furnace as a ventilating power, and it is now very generally gone out of practice. Since the introduction of steam pumps to discharge the waters of mines, exhaust steam is frequently used to promote a current of air in the mines of the Mahoning and Tuscarawas valleys of Ohio, but left to its own efforts, especially during the summer months, when the air outside is warmer and lighter than the air under ground, it serves very little purpose.

The exhaust fan is one of the oldest and best motive powers for ventilation. For shallow mines it is better than the furnace, and in deep and fiery mines it is rapidly supplanting the furnace, even in England, where the furnace has been the favorite method since the days when active mining began. Agricola mentions the fan in use in the German mines of his day as consisting of straight, radial vanes. Fan ventilation has always been the favorite method in Belgium, where the deepest coal mines in the world are located.* Many of the fans applied in the extensive mines of England are of immense size, having diameters, in many cases, of forty feet, and capable of producing two hundred thousand cubic feet of air per minute. Since the terrible catastrophe of the Avondale shaft in Pennsylvania, which was caused by the furnace setting fire to the wooden structures on top of the mine, exhaust fans have come into very general use in that State, giving the most satisfactory results.

The furnace has still a decided preference among practical men in Ohio. There is, so far, but one fan in the State, a very poor one, indeed, but there can be no question as to the fan's superiority over the furnace, as our mines, being generally quite shallow, present physical imperfections to perfect furnace ventilations, except at the cost of constructing spacious air passages. A deep shaft gives rise to a long, upright column of heated air, and consequently causes a more powerful ventilating force, the practical power of the former being in proportion to the depth of the shaft, and that power being as the ratio of the depth.

Air, in being heated, expands 1.459th part of its volume, by Fahrenheit's scale, for every degree of heat applied to it. One thousand cubic feet of air, at a temperature of thirty-two degrees, expands to one thousand three hundred and sixty-six feet at two hundred and twelve degrees. In proportion to the heat applied to air, it becomes lighter, bulk for bulk, and flies upward, while the column of unexpanded air presses down to supply the place of the air displaced through becoming rarified, Every degree of heat applied to the ascending column of air increases its expansive power, and consequently increases its moving power until the limits of the furnace are reached, which are due to the frictional resistance which the air encounters in passing along the bottom, sides, and top of the air-ways of the mine. At this point any increase in the heat of the furnace is to no purpose; coal is burned in vain. To get a larger volume of air the air-courses must be shortened or increased in size.

The production of a circulating stream of air in a mine is not possible, no matter what forces may be applied, until two separate openings are made and communication established between them—one of the openings to receive and the other to discharge the column of moving air. But when this is had, if the openings stand one higher at the surface than the other, the higher opening will discharge air in winter and the lower one in summer, without the application of artificial force, because of the relative densities of the two atmospheres in the upcast and downcast shafts. In the spring and fall seasons, however, when the mine and surface air approach each other in density, the underground current is weak, languid, and is under no control, and frequently there is no motion whatever. There ought to be artificial power applied to all mines, deep and shallow, shaft or drift, to have systematic perfection in ventilation. The natural forces may be sufficient for mines of limited extent, where only a small force of workmen are employed, but even in such cases they will be found inadequate at certain seasons of the year.

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* In the province of Hainault, in Belgium, coal is working at the depth of 2,820 feet (860 metres) at the Colliery *des Viviers*, at Gilly, near Charleroy, and one pit, at the same place, has been sunk to the serious depth of 3,411 feet (1,041 metres).

WARRINGTON SMYTH.

In the due ventilation of a mine the currents of air are guided and directed by trap-doors, stoppings, brattices, etc., in order to throw them forward to the faces of the workings, for the natural tendency of the circulating stream is to seek out and return to the upcast by the nearest and most direct route. In the more extensive mines of England—particularly those which produce copious emissions of fire-damp—the air is divided into separate splits, or currents, for separate divisions of the mine. Each current is kept separated from the others, from the moment the splits are made, and traverses its own special district, when, having returned to the bottom of the upcast, they are all reunited and delivered to the onter world, loaded with all their impurities. The advantages of this system are many and important. An explosion is confined to the division of the mine where it occurs, which limits its destructive force, and there is much less liability to explosion, because the air is purer and better. A much more powerful current is produced with the same ventilating powers, because the routes are shortened, and the frictional resistance reduced.

The following statement, taken from a paper by J. J. Atkinson, an eminent mining engineer, and for many years one of the British inspectors of mines, published in Vol. III. of "Transactions of the Northern Institute of Mining Engineers," shows the power derived by splitting the air: 7,288 cubic feet, in 1 column, will produce, with a constant ventilating pressure, 66,669 cubic feet, in 5 equal and similar parts; 103,280 cubic feet, in 10 equal and similar parts; 111,421 cubic feet, in 15 equal and similar parts; 113,704 cubic feet, in 20 equal and similar parts. And with a constant ventilating pressure, 16,198 cubic feet, in 1 column, will produce 70,884 cubic feet in, 5 equal and similar parts; 94,850 cubic feet, in 10 equal and similar parts; 99,772 cubic feet, in 15 equal and similar parts; 101,132 cubic feet, in 20 equal and similar parts.

Elaborate arrangements of this character are not necessary in the coal mines of Ohio, because of their comparative freedom from fire-damp; but they will become necessary some day, when the mines are opened on the lower coals, near the center of the basin, as the fire damp will be given off abundantly. The main objects to be kept in view in the present state of mining, consist in the proper and timely construction of a furnace, fan, or other ventilating power, and in proper and timely arrangements for the distribution of the air. Neglect of these matters lies at the bottom of all the bad air of mines in the State.

As the furnace still retains a decided preference among practical men, the laws which govern it should be carefully studied and well understood by the mine superintendents. A mistake cannot be made in constructing a large furnace, and coal is both abundant and cheap at a coal mine. The grate should be from four to six feet in length, the height above the bars should not be less than three feet, and there should be at least two feet below. Every upcast shaft should have at least thirty feet of sectional area, and be made dry with incombustible lining. Water falling down an air-shaft, or running down its sides, greatly impairs the force of the air current. But no matter how well a furnace may be constructed, nor how carefully the upcast may be maintained, coals will be burned to no purpose if the air-courses are not properly constructed, and made large and roomy. Spacious air passages will admit of the easy and abundant flow of air.

There may be many times the amount of air passing into a mine and returning by the upcast, and yet the miners be suffering for want of a healthy ventilation in their working places; and this fact was frequently met with in many mines. The air-courses were either too far behind, or the air was permitted to leak and split at every door and stopping, until the whole of the current was lost before it reached the miners, whose lamps were burning dimly—sometimes even their combustion could only be maintained by hanging the lamp downwards—and the men themselves were gasping for breath, so to speak, in an hourly thickening atmosphere.

Since the mining commission examined the leading coal mines of the State three years ago, a very marked improvement has taken place in ventilation, particularly in the Tuscarawas valley. I found many cases where old furnaces had been torn down, and more powerful ones put in their places; in some cases two furnaces were in operation. The stoppings had also been more carefully watched and kept air-tight, and the air-ways themselves kept well up to the faces of the workings. Many of the more thoughtful and intelligent of the responsible managers are now driving double entries, which are always kept abreast, from which air-holes are cut from the one to the other, and securely stopped, as newer ones are made, thus delivering the current of air to all the entry faces.

THE COAL RESOURCES OF THE STATE.

The Coal Measures of Ohio form part of the great Alleghany coal field, which extends through portions of nine States—Pennsylvania, Ohio, Maryland, West Virginia, Virginia, Kentucky, Tennessee, Georgia, and Alabama, and includes an area of fully fifty-five thousand square miles, being upward of seven hundred miles long, and averaging nearly eighty miles wide. The State of Ohio contains more than ten thousand square miles of the most favored portion of this field—the coal area extending from Geauga county on the north, to Lawrence county on the south; and from Jefferson county on the east, to Holmes county on the west.

There are no less than ten different minable beds of coal in the State; they do not all, however, extend over the whole of the coal area, for the Alleghany coal field, in common with all other coal fields, possesses a basin shape; hence the lower seams occupy much greater areas than the upper ones. The deepest place (the basin) of the coal strata is on the Ohio River, between Bellair and Pomeroy. At this point the coal-bearing rocks are from fourteen to fifteen hundred feet thick, and inclose all the seams of the series. North and west from the basin the rocks rise toward its margin, and one after another of the different coals crop out, till reaching the extreme outcrop, the lower coal of all—the famous Briar Hill seam—comes to the surface and disappears forever.

Although the absolute slope and structure of the coal field of Ohio has been ascertained with remarkable accuracy by the late careful and able Geological Survey, the estimates made of the amount of available coal are beyond all question too high. Borings made in different parts of the coal area for oil, salt, etc., as well as examinations made along the flanks of the several seams where they crop out, or come to grass, in deep surface erosions, show that few of the lower coals are persistent, and that a coal of a minable height in one region is frequently found too thin in another region to make it of any immediate or prospective commercial value. The coal of some seams appears never to have been deposited over parts of certain areas, or to have been wholly removed, after deposition, by denudition. Besides, our coal beds, in common with all coal beds, from whatever field in the world, are subject to rock-faults, horsebacks, and other mining troubles, which give cause for quite an item of subtraction.

Although our coal area includes ten thousand square miles—equal to that of Great Britain, it does not follow from this fact that we possess an equal amount of available coal; for the Coal Measures of Ohio are nowhere more than fourteen or fifteen hundred feet thick, while the Coal Measures of England in some districts—that of South Wales—are fully ten thousand feet thick, though coal can never be mined at half that depth. Taking, however, four thousand feet as the available mining depth, the limit at which the Royal Coal Commission of 1871 puts it, and the coal area of that country is still more than double that of ours. The thickness, and number, and quality of the beds must also be considered equally with their extent of area, in forming comparisons of this nature. Our thickest coal, that of the great vein of Hocking, Athens, and Perry counties, nowhere exceeds twelve or thirteen feet in thickness, while the ten-yard coal of Dudley, Wolverhampton, and Billston, in England, is from twenty-four to thirty-six feet thick. The maximum thickness of our coal may be stated at forty-five feet; in the North Staffordshire district they have one hundred and forty feet, and forty different beds of coal, seams of two feet and under not being considered. But so far as quality is concerned, we have no comparisons to fear.

In his recent work on Coal and Coal Mining, Warrington Smyth considers the amount of available coal in the British Isles at eighty billions tons, Edward Hull, of the Geological Survey, having several years previous made the same statement, the depth of mining being calculated at four thousand feet. The Coal Commission puts the amount at ninety thousand two hundred and seven millions tons as proved coal, and adds fifty-six thousand two hundred and seventy-three millions tons as having a probable existence at workable depths (four thousand feet), under the Permian and New Red Sandstone formations. Some years ago Mr. Henry Hussey Vivian made the extraordinary statement in the House of Commons that, not only was four thousand feet not the workable depth of coal mining, but that twenty-four billions tons could be raised from the South Wales coal fields alone at a greater depth than four thousand feet.

The deepest mines in England are the Pendleton pit, which is two thousand two hundred and fourteen feet deep, and the Rosebridge pit, two thousand three hundred and seventy-six feet deep. A pit at Charleroy, in Belgium, is two thousand six hundred and forty-nine feet deep, and another has been sunk, but is not working, to three thousand feet deep. Warrington Smyth, on the authority of Prof. Trasenster, of Leige, puts the depth of the Belgium mines at much greater depth, respectively two thousand eight hundred and twenty feet, and three thousand four hundred and eleven feet, but he is evidently mistaken.

Before even four thousand feet of workable depth is practicable, some other means of ventilation will require to be discovered and applied to coal mining. The heat of a mine increases about one degree of Fahrenheit's scale for every sixty or seventy feet of descent; at three thousand feet the temperature would be one hundred and two degrees, and at four thousand feet one hundred and twenty degrees. Rapidly moving currents of air may cool the working faces several degrees below these figures, and compressed air may still further cool the temperature, but no miner can work to any advantage in a temperature exceeding eighty degrees.

The ten minable beds of coal of Ohio will aggregate forty to forty-five feet at many points on the Ohio river. As, however, the upper coals, by reason of the basin slope of the field, occupy but limited areas, and no coal seam, not even the lowest, extends over the whole of the coal area, a very heavy discount must be made in forming any estimate of the average thickness applied to the whole coal area. Nine feet will approximate it, and when due allowance is made for waste by crushed and lost pillars, and small coal lost in screening (being at least one-third of the whole), there is left but six feet of merchantable coal. This estimate would give sixty-two billion nine hundred million tons as the aggregate commercial yield of Ohio, which, at the present rate of consumption, would require a period of twelve thousand five hundred and ninety-two years to consume it. It would supply the whole of the United States seventeen hundred years, and Great Britain nearly five hundred and eighty years, were no yearly increase made to their outputs.

The main mining centers in Ohio are the Mahoning valley, the Tuscarawas valley, the Hocking valley (including Straitsville and Shawnee), Salineville Bellair, Steubenville, Pomeroy, Ironton, Coshocton, Cambridge, and Letonia, in addition to many other important mining districts along the lines of the several railroads which traverse the coal fields.

The coals which lie in the northern and western flanks of the coal area are more eagerly sought for and mined than those of the more central part of the field, as they distance competition in the supply of the great coalless area lying to the north and west. In most cases, too, these coals are of very superior quality.

The mines of the Mahoning valley, the Tuscarawas valley, and the Jackson and Steubenville regions, are mainly shaft openings, the coal being generally below water level. The openings of the Hocking valley, the Pomeroy district, the Cambridge, Coshocton, and Ironton localities are drift mines, the coal being reached without sinking. In some of the regions, where the strata dip rapidly, as at Bellair, part of the mines are level free, and part are shaft openings.

Although the Coal Measures dip from the flanks of the coal area towards the basin of the great Alleghany coal field, this dip is by no means uniform throughout. The strata sometimes rise along the general line of direction of the dip, forming a synclinal or trough, and then commence dipping again, forming an arch or anticlinal. These folds of the strata, Prof. Newberry says, are due to the same agencies which caused the upheaval of the Alleghany Mountains. In addition to these undulations, there are a multitude of local troughs and arches, some of which are seen in every coal mine in the State, which the miners call "swamps" and "hills." These hills and swamps are, in my judgment, the result of inequalities in the floor of the coal marsh, existing when the original peat-bogs, from which the coal is derived, was deposited. In the lower coal—that of the Mahoning valley, the Tuscarawas valley, and the Jackson region, they abound in every coal opening, but they are also met in every seam of the series, the hills generally growing less steep and high as we ascend in the Measures. In the Mahoning valley the coal troughs or swamps are often more than one hundred feet below the level of the upper surface of the "flag-rock"—the Waverly sandstone, though I have never seen the coal to rise in the hills to a greater height than sixty or seventy feet before it thinned out. In the second minable bed of the series (Prof. Newberry's No. 3), which, along the outcrop of the field in the Mahoning and Shenango valleys is only found in patches, the hills are neither so high nor so steep as in No. 1, but the coal itself rises to heights fully equal to it, and preserves a greater uniformity of thickness, though growing gradually thinner on the hills. In the mines of Coshocton, opened in No. 6, a swamp runs along the face of the coal, from which the strata in some places rise on both sides, at the rate of five hundred feet to the mile. In this swamp the coal is five feet thick, and is divided into two benches by a parting of fire-clay two inches thick, the lower bench being here twenty inches. As the coal ascends the hill, the lower bench grows gradually thinner, till it disappears altogether; then the fire-clay bench is cut out, and still further upward the lower part of the upper coal is thinned away, until the seam has become too low to follow further with profit to the mine operator.

Whether this swamp would be found immediately below on the next seam of coal, and would run in the same line of direction, could only be ascertained by an appeal to facts, of which I had no means at command; but I have observed in other parts of the coal field that such undulations are local, confined to single seams, and that swamps, above or below any noted swamp, are neither vertical in position nor follow the same bearings of the compass, causing the strata between two coals to be thinner and thicker in places.

THE LOWER COAL BED.

Nearly one-half of the annual aggregate coal production of the State is drawn from the lower coal seam (No. 1 of the Geological nomenclature), its main mining centers being the Mahoning valley, the Tuscarawas valley, and the Jackson county coal region. In the Mahoning valley it is known as "Briar Hill coal" and "Mineral Ridge coal," in the Tuscarawas valley as "Massillon coal," and in Jackson county as "furnace coal" or "Jackson coal." It is, in general cases, a magnificent furnace coal, and is mainly used for smelting iron as it comes from the miner's pick. The Briar Hill coal of the Mahoning valley is, perhaps, superior to the coal of all other points. Like all furnace coals, it possesses a laminated structure, splitting into sheets, and is very difficult to break on the opposite side of the lamina. The faces of the layers are often covered with a soft, dead carbonaceous material like charcoal, and the whole seam throughout is marked by alternate layers of dead and bright looking coal. In the act of combustion it neither swells nor changes form in the furnace, the blocks retaining their shape until they fall to ashes.

Unlike other coal seams which generally exist in good regularity, this coal is often wanting where it might well be expected to be found, and it has to be searched for by boring at great risk and expense, not one acre in twenty in the Mahoning valley being found to contain it. It rests upon the upper surface of the Waverly sandstone, or upon a coarse-grained sandstone which often covers the Waverly, varying in thickness from a foot to twenty feet. In the low places there is generally a foot or eighteen inches of black shale under the coal, but there is seldom any fire-clay, except in the Jackson region, where a stratum of fire-clay is present. The upper surface of the Waverly sandstone is very wavy and uneven, forming in places long, sinuous troughs, often very narrow, and the coal is always got in these troughs. In the hollows the coal is generally found of good minable height, ranging from three and a half to five feet; but on the sides of the hills it becomes thinner, forming the shape of an acute angle or of a wedge, though a minable thickness of coal is frequently suddenly cut away on the hill-side (and in places in the hollows also) by the appearance of a roof of sandstone or fire-clay, which usurps the place of the coal. When this foreign roof stays away the coal generally exists on the hills, though growing thinner with each yard of advance until it reaches the summit, when it dips over again into the bottom of an adjoining trough, forming an arch or an anticlinal. Unless there is a swamp or hollow near, the coal is invariably cut away on the hills before it thins out, by the presence of the the white roof, and it will frequently happen that the coal will rise on one side of the hill for forty or even sixty feet, perpendicular height, and still exist of a foot or more in thickness; while on the other side of the hill it will be cut away altogether before it has risen fifteen or twenty feet—a minable coal disappearing with six feet of advance by the white roof of sandstone or fire-clay having been encountered.

In the mine of the Fulton Coal Company, near the village of Canal Fulton, in Stark county, there is a hill of immense height—the highest, I believe, ever met with in any coal mine in the State—the top of which is fully sixty feet higher than the swamp. The coal rises from the side of the swamp, climbing up the side of the hill for one hundred and fifty yards at the rate of about one foot to four. When reaching the summit it flattens off for a few feet, then dips down into a swamp on the opposite side. In the hollow or low place of the coal in each swamp the seam is nearly five feet thick, while on the summit of the ridge it is scarcely six inches.

All these hollows, troughs, or swamps in which this coal bed is found, appear to have been scooped out through erosive agencies. Wherever it is necessary in a mine (as it is quite frequently) to cut a passage-way through a hill, the strata underlying the coal are found occupying a horizontal plane, while the coal may be pitching at a rate of twenty or even thirty degrees. This scooping of the rocks was done long before the deposition of the coal vegetation. To this fact is due the limited amount of coal No. 1, or rather it is to this fact that there is any of this coal at all, for it is never present on the plateaus which compose nine-tenths of its area. What changes may be encountered in the more central portion of the field is a matter of much speculation—the opinion prevails among practical men that it is wanting altogether. Whether present in equal amount towards the basin of the field, or in even greater quantity, the cost of boring will prevent, for many years to come, any very active search for it.

In many places in the Mahoning valley the roof of the coal is a conglomerate rock. The Seceder mine and the Moore mine, in Liberty township, have generally a conglomerate lying immediately above the coal, and patches of this rock cover the coal in the mines of the Vienna Coal and Iron Company, in Vienna township, while the same roof is present in places in several of the mines of Mineral Ridge. A conglomerate rock of two or three feet of thickness is also found in the Jackson coal region of southern Ohio, not directly above the coal, but in the roof-shales twenty-five feet above the coal, and the pebbles are generally quite large, from one to three inches in diameter.

All the material above the coal, as proved by numerous borings and by the opening of the shafts, show that the strata are not regular, persistent matter, but local layers of shale and sandstones without extended unbroken arrangement. One shaft, sunk to a depth of one hundred and forty feet, may not possess a single foot of sandrock, while the next one, not a half mile distant, sunk to the same depth from the same line of level, may have twenty or thirty or forty feet of rock, either in one or in several masses or layers. These rock beds may be near the coal, in fact they sometimes form its roof, or they may be near the surface. They are never continuous, but appear and disappear in short distances, and are found in beds of one foot and in beds of ninety feet of thickness, and the same is true of the various shale strata, except that no single bed is ever met exceeding twenty-five to thirty feet of thickness.

In the Tuscarawas valley the basins appear to be of greater width than in the Mahoning valley, and the hills are not so numerous. In Jackson county the coal is spread over still greater breadth than in the Tuscarawas valley, and here the swamps or low places in the coal, instead of being long, serpentine troughs, are generally rounded like a bowl. In the mines of the Star Furnace Company the coal occupies three different stages of level, and here, which is unusual in this district, the swamp is long and sinuous. From the lowest place in the coal to the highest point there are forty-five feet of elevation. The coal first rises out of the swamp by a gradual inclination of about twelve degrees, till it has reached eleven feet, then it flattens off, forming a plateau of perhaps one hundred and fifty yards in width, then rises again and levels out as before, and still again rises until the alluvial cover of the outcrop is reached. There is seldom any foreign matter (sandstone or fire-clay) found usurping the place of the coal either in the basins or on the hills.

At the mine of the Milton Furnace and Coal Company, twelve miles from Jackson Court House, the coal is comparatively level in all directions; but this is an upper seam—the Anthony or Hill coal of Prof. Andrews—though it is, perhaps, of equal purity and value as a furnace coal to that of the Jackson shafts, being free from sulphur, and open-burning in the furnace

CONDITION OF THE MINES.

The first two months of active field duty were mainly given to an examination of the mines of the Mahoning valley. The mines of this region are all below water level, and range in depth from forty feet to two hundred and forty. The shafts are sunk sometimes perpendicularly, at other times they slant across the rocks, dipping at the rate of about one foot in three; these latter are called slopes, and are generally made ten feet wide and six feet high, with single tracks. The shafts are made from eight to nine feet wide, and from sixteen to eighteen feet long, the hoisting-way being double—one cage coming up with a loaded car as the other goes down with an empty one.

All the workings are carried forward on the same general plan or system; the main entries all being driven along the lowest places, or "swamp," in the coal, and the side entries along the butts of the coal, without regard to the "swamp." The rooms are carried forward on the face at right angles from the butt entries, and are from seven to ten yards wide—from two to five yards of coal being left between the rooms as pillars, to support the roof of the mine. Openings are cut through the pillars from one room to another every few yards. Most of the mines have two separate openings, which, when spoken of in connection with the ventilation of the mine, are always called upcast and downcast shafts. Shafts with one opening have a wooden partition, or box, in the shaft, making two compartments, to receive and discharge the air. The plan of ventilation is usually the same at all the mines; but there is frequently a marked difference in the condition of mines, as far as perfecting the ventilating arrangements, and supplying the workmen with air is concerned; and this is due to the ignorance or carelessness of the bank bosses rather than to any disposition of the operators of a mine to withhold good ventilation. Many bank bosses receive instructions to provide plenty of good air for the miners; and yet such miners, in good part of their workings, are nearly always in a criminal state for want of air. The current may go in the mine, but it is not properly distributed; it leaks at every door which is badly hung.; it leaks at every stopping which is not made air-tight, or, since it was built, has "settled," and the air is escaping at the top. Then the air-courses themselves, instead of being well forward to the entry faces, are away behind, often for one hundred yards, and the men in advance are working in an atmosphere wholly stagnant, which becomes thick with vapor, and foul with noxious matter, hour after hour, till the lamps will scarcely burn, and the workmen's heads are like to split with head-ache. The furnace is also neglected—it has no regular attendant, or the person in charge is not looked after. The doors for guiding and directing the current in the main traveling and roadways, are also badly hung, or they are left open one-fourth of their time, having no trappers; or the boys have wandered off in play, or have gone away inside with the drivers. If the miners complain of bad air, the boss will likely tell them they don't know anything about bad air—he has worked many a time in an entry or room where it took a man to hold two lamps together to keep a light; and if they don't like the air, they can quit, etc.

At the next mine all is different; the air-courses are kept up well; the doors are all tight, or are as tight as they can be made—for air will leak through a door at best; the stoppings are overhauled regularly; the air-ways have been recently traveled over to see that no fall has choked themu p, or partly closed them; the furnace is well attended. At this mine the men are better contented. There is no growling or quarreling with the boss; there is no talk of a strike; the best class of workmen in the district are here at work, for men of sense and intelligence will not stay at a mine with bad air if they can get work elsewhere. It may be here stated as a fact worthy of mention, that when the proposition to strike in January, 1872, was being entertained by the miners of the Mahoning valley, the miners of the Brookfield slope alone were opposed to the inauguration of the strike, and voted solidly against it. This mine, although all the coal has to be blasted, and some hundred kegs of powder are used in it every month, is one of the best, and has always been one of the best ventilated mines in the Mahoning valley, or the State; and it is one of the most extensive, making it difficult to ventilate, for air, as is well known to intelligent, practical miners, will not move along a long, narrow passage-way with the same force as a short one, being retarded by the friction which it encounters from the roof, floor, and sides of the gallery.

I made my first visit to the McKennie shaft, in Mahoning county, operated by J. B. Warner & Co. The ventilation was fair. The mine had two openings, well separated from each other; in the downcast shaft there was a ladder by which the miners could find ingress and egress at any hour of the day; the hoisting-shaft was, however, used for lowering and raising the men. There was a steam-pump at the bottom of the upcast, or hoisting-shaft, the exhaust from which was used to rarefy the air—an arrangement, as noted in a former part of this report—which is of good assistance to the ventilation so long as the outside air is heavier than that of the mine, but serves very little purpose in the summer, when the higher opening becomes the natural downcast, and the forces of nature are reversed by the exhausted heat of the steam, which is often scarcely greater than the hot summer air, and, consequently, can impart little force to the circulation. One of the ropes was bad. I called the attention of the operators to the requirements of the law as to safety-catches and covers for the cages, and also gates for the top of the shaft, and they promptly went to work and had these appliances provided.

The Wick and Wells' shaft was examined on the 9th. This mine has but one opening, the shaft being divided into upcast and downcast divisions for air. The cages were covered, gates placed on top, and safety-catches applied. The shaft is one hundred and eighty feet of perpendicular depth, and is ventilated by the agency of the exhaust steam from a steam-pump at bottom of the mine. The work of sinking this shaft was one of the most difficult and costly undertakings ever encountered in the United States, mainly by reason of the flow of water. The time occupiod in sinking, including several long stoppages, was about two years and six months. The shaft was first let by contract to a party of four miners, at twenty dollars a foot, the company (Messrs. Wicks and Wells) agreeing to furnish pumping machinery for the discharge of water. The sinkers only succeeded in getting down to the solid material, when, finding it was impossible to complete the work, with everything in their favor, for the price, they threw up their contract. A young Scotchman, a mining engineer, highly educated in his profession, undertook the work at thirty-five dollars a foot, but also gave it up after a trial of three weeks. A third party took it at fifty dollars a foot, which was a fair price for work of this character on good ground. This party, strongly impressed with the necessity of having the water under absolute control at all times, sunk a seven-inch drill-hole, in one corner of the pit, down to the coal, into which they introduced the suction-pipe of a No. 6 Cameron steam-pump, suspending the pump in the shaft, and lowering it as the sinking progressed. This arrangement worked very well; but the rock was very difficult to blast, the sides of the shaft were hard to dress, and the undertaking was a loss from the first day. The rock—a coarse-grained sandstone—was of a very porous nature, into which it was impossible to introduce naked powder for blasting. It had no partings, and the work of sinking was slow and costly, but the contractors persevered on, knowing that the sandstone, as revealed by the borings of the large drill-hole, would be softer and easier to blast the deeper the pit went into it.

But every additional foot of depth increased the volume of water, till, at the depth of sixty feet the pump was kept running at its full capacity. The contractors now applied to Messrs. Wicks and Wells for additional pumping power, which they felt very reluctant to provide. The sinkers wanted a duplicate pump, as the breaking of any part of the one in use would necessitate its withdrawal, and fill the shaft with water, entailing needless expense and loss of time. After much hesitation and equivocation they got a second-hand pump of the same number, but of larger make, no part of which could be used on the other pump, and this third party were forced to give up the contract, having lost two thousand dollars in the shaft. Most of this loss, however, was in sinking the large drill-hole, reconstructing machinery, and in the purchase of tools and fixtures for handling the pumps, and in a forfeiture of sureties (ten dollars a foot), for the completion of the work.

Messrs. Wicks and Wells now concluded to sink the shaft by day work, hiring and paying the workmen themselves. A second pump was soon found necessary, and then a third one, pump after pump being added until six steam cavern pumps were in the shaft, capable of discharging three thousand gallons of water per minute. As it was impossible to get along with so many pumps in the shaft, the work of sinking was suspended below, and the sinkers put to cutting a second shaft alongside of the main one. This second shaft, which was eight feet wide by twelve feet long, having been sunk to the level of the larger one, two pumps were lowered into it, and the other four kept working—all of the suction pipes being in the main shaft, the pipes of the two pumps of the small shaft being led through a gallery. At the depth of one hundred and ten feet a large, irregular crevice of the rock was struck as the sinkers were drilling a hole, from which the water rushed with such force as to throw the drill high up in the shaft, and all the pumps were overpowered. They were all withdrawn, and the shaft filled with water.

After some weeks of stoppage, all the pumps were again set to work, and the water pumped out down to the point where the pressure of the water and the powers of the pumps were balanced. Here all the pumps were run to their fullest capacity for four weeks, discharging three thousand gallons a minute, in the hope of emptying, or of at least controlling the feeders of water, but no impression was made. It was deemed necessary to further progress to procure one powerful pump, equal to the combined force of the six in use. Accordingly one with a steam cylinder twenty-six and one-half inches diameter, and a water cylinder of sixteen inches diameter, with fourteen-inch suction pipe, and five-foot stroke, made expressly for the purpose, was brought into requisition. The water was now mastered, but the great difficulty was to get a sump made below the crevice so as to get a chance to close it up. The bottom of the shaft was a vast array of suction pipes, and the water flowed in from the crevice in floods. The pumps suspended above the workmen filled the shaft. Every one who has handled pumps in sinking will conceive of the difficulty of keeping so many pumps and pipes, suspended as these were by iron rods, in working order, all having to be lowered as the sinking progressed. A cutting two or three feet below the crevice was finally accomplished, when the sinkers addressed themselves to clearing it out so as to fill it with wooden blocks to dam back the flow of water. These blocks were well wedged in and caulked, and the crevice water was finally shut off and controlled.

The work of getting below the crevice was one of unparalleled difficulty and danger. The workmen, suspended in buckets, with scarcely room to get through the multitude of pumps, labored heroically, while the water rushed and shot across the shaft. It is a matter of great satisfaction that during the whole of the undertaking not a single accident occurred.

The closing of the crevice reduced the flow of water to five hundred gallons per minute, and no further difficulty beyond that encountered in ordinary sinking was encountered. After coal was reached and opened, the water increased to one thousand gallons per minute. The large steam pump and the six smaller ones were all removed, and a pump capable of discharging two thousand gallons a minute substituted. This pump has a 24-inch steam cylinder, 14-inch water cylinder, 4-foot stroke, and 14-inch suction pipes.

There were six 30-feet boilers, with 36-inch head, in use during sinking, all of which are yet used, though four can do the work; but it is not thought bad economy to use them all. The cost of work and supplies for sinking the shaft was $71,837; the cost of a shaft of equal depth in the same material would scarcely reach $20,000, including machinery. The depth of the shaft is one hundred and eighty feet, of which the first fifteen feet was drift, then followed one hundred and thirteen feet of sand-rock, the remaining material being slate. The size of the shaft is eight by sixteen feet, of rectangular shape, as all the shaft mines of the Mahoning valley are made.

As the vast volume of water encountered in the shaft is dammed back over the heads of the miners, great care ought to be exercised in advancing the workings of this mine, leaving pillars of extra strength and thickness, to prevent the possibility of a crush; and a second opening, sunk on the highest ground in the mine, ought to be provided, having a straight and well understood passage-way leading to it from the workings. A sudden inflow of this pent-up water would be attended with danger to the under-ground people.

In some of the coal districts of Belgium, France, and Germany, where the Coal Measures are covered by the newer strata of the Cretaceous and Tertiary formations, through which not only immense streams of water flow, but sometimes beds of loose or running sand are encountered, a number of undertakings, consisting in sinking shafts by boring them out after the manner of boring artesian wells, have of late years been carried to a successful issue. This mode of sinking is due to the skill and perseverance of two engineers, Messrs. Kind and Chaudron. The first effort of this character was undertaken in the year 1863 at the shaft of the Hopital Coal Company, St. Avold, in the coal basin of Saarbruck, in the north of France. A number of unsuccessful efforts had been made to sink the pit by the ordinary way, and more than four millions dollars had been expended in fruitless attempts, when Messrs. Kind and Chaudron brought forward their boring tools, consisting of enormous trepans, one of which weighed fifteen tons. Three engines were erected at the shaft, one for hoisting and lowering the tools in the shaft, and for lowering the tubing, the second for working the drilling rods, and the third for pumping hot and cold water to supply the boilers. The shaft, which was fourteen feet in diameter, was sunk to the coal in three years and six months from the date of underground operations. Its depth was nearly sixteen hundred feet perpendicular.

Two shafts were in progress at the same time (the second being a small one for air), and they were both successfully completed and securely lined with water-tight lining down to solid and dry material, a distance of five hundred and twenty feet from the surface, before the water was pumped out of the shaft. The work of tubing the shaft and securely damming back the water was the greatest achievement of all; it consisted in the lowering of immense metallic cylinders of cast iron, divided into sections and jointed together, the joints being made water-tight by an outer wall of well-packed moss, which was securely fixed in place by iron bands or rings five inches wide. The bottom of the tubing was also packed with well-picked moss, which rested on the solid and even bottom, and was squeezed down by the weight of the iron casting. The space between the tubing and the wall of the shaft was now filled and puddled with concrete to form a solid wall of lining. The weight of the tubing in the hoisting shaft was six hundred and thirty-five tons, that of the air shaft two hundred and fifty-eight tons. The whole cost of the undertaking, including the purchase of boring tools, engines, etc., which was one-third of the expense, was one million four hundred thousand dollars.

Since the completion of these shafts many other operations of a similar character have been performed where it would have been utterly impossible to get to the coal by the common mode of sinking, and the cost of sinking has been less in many cases than that of blasting out the rocks, practically demonstrating that this plan will yet supersede all others. Fuller descriptions of these operations will be found in Vol. 20 of entry men are always in bad air. The passages for the air are often very narrow, and are, in some places, nearly closed by falling material, or by debris thrown into them. I measured the amount of air passing through the workings with a good fire burning in the furnace, and found no more than ten thousand cubic feet per minute; but when the doors were opened, allowing the air to travel by a more direct and spacious route to the upcast, the current was doubled in quantity, showing the influence of friction in retarding its passage through confined air-ways. The furnace of this mine is the best constructed in the State, and if the fire was properly kept up, and all the air arrangements were made in proportion to the size of the furnace, the mine could be made to circulate fifty thousand cubic feet of air per minute. In the shaft of the Steubenville Coal and Iron Company there were thirty-nine thousand cubic feet of air in circulation with a smaller furnace, but at this mine every thing was proportioned to the size of the furnace. The air-courses were nowhere less than forty-seven feet area, and the upcast was the same size. At the Church Hill slope the air-courses bore no proportion to the furnace, and the power of the furnace was greatly impaired.

There were many complaints by the miners at the Church Hill slope that the fire was not kept up in the furnace. It was in charge of a sickly miner. The superintendent promised me that he would put another man to assist, but on my last visit no change had been made, though it was claimed that the fire was being properly kept up now.

This mine is very extensive, and usually employs from one hundred and fifty to one hundred and ninety inside men and boys. The coal lies in a succession of swamps and hills, none of the latter rising to any great height, except on the flanks of the basin, where the coal thins out on the hills. The coal is of magnificent quality and fine minable height, having a good roof and floor. The entries are very wet, as the swamps discharge torrents of water.

I visited this mine again in September, having received complaints of bad air from some of the men. They also complained of the want of a proper traveling-way up the slope. I examined the state of the air, and found a good deal of improvement on my second visit, though there were yet places unfit for the abode of the miners. One of the worst places had been stopped before my arrival.

The passage up the slope is not inviting, and needs improvement to make it safe. The cars start first, the men following behind. Before the miners reach near the top, the empty cars are pushed over and go flying past, the people taking refuge on the side of the slope. To get out of the way they have to climb over the pipes and pitments of the pump, as

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the 20th, were found in good order. There are three large mines belonging to this company, located near the village of Coalburg, one of which was idle at date of visit. One of the mines made a little fire-damp in one of the butt entries. There was no safety-lamp at the mine; the workmen brushed out the fire in the morning with their coats. I directed the superintendent to get a safety-lamp, and to forbid the miners from going up until the state of the air was ascertained by the safety-lamp; for while the accumulation of gas was of small quantity, and readily diffused, it ought not to be trusted too far.

The coal of the Stewart mine gets unusually thick in some places; I measured eight feet of thickness, part of which being cannel coal. Many of the miners at No. 3 were unskilled workmen, and made a great waste of coal in blasting.

The mine of the Kyle Coal Company, a perpendicular shaft one hundred and eighty feet deep, examined on the 21st, had but one opening. The ventilation was produced by exhaust steam. The mine made fire-damp, and all the air-courses were kept well forward; there was good air. The miners were in the habit of examining their places themselves with the safety-lamp, there being no regular fire-viewer. I directed the superintendent to appoint a competent person for this purpose, and to have the mine examined before any of the miners were allowed to enter. This mine had a patent hoist, with safety-springs, or catches; the guides being lined with iron ratches to catch the cage in case the rope should break.

Weathersfield shaft was made the subject of two visits, the second one being made in September, by request of the company, to advise as to providing suitable covers and safety-catches for the cages, and for more approved means of egress in case of fire at the hoisting-shaft. The mine had two openings, the air-shaft being used for an upcast, at the bottom of which was placed the ventilating furnace. Were a fire to break out at a shaft, even with two openings, where the second one is an upcast with a furnace, it is feared that safety is not assured, and many of the miners contend that a compliance with the statute requires that the two outlets shall at all times be provided with apparatus to have the men immediately withdrawn in case of accident to one of them. I have given no opinion on this question, as it will be brought up in court for settlement after the law goes into force providing for two outlets. I may say here, however, that where a ventilating furnace is placed at the bottom of the hoisting-shaft there can be no danger to the men below from fire, as the smoke and gas would be thrown up and not down. In the other case, a fire at the main shaft would send its smoke and gas down through the mine, until the increasing heat of the fire would become greater than the heat from the furaace at the other shaft, when the ventilating current would reverse itself, and the gas and smoke from the furnace would spread through the mine. Could the miners, under such circumstances, reach the upcast, or furnace shaft, put out the fire, and escape to the surface before being asphyxiated by the deadly furnace fumes? If a second opening does not assure safety in such cases, neither would a third one, even if it had no furnace, and were a downcast shaft; for the gases from the fire of the burning buildings and those from the furnace shaft would find their way to the miners as surely and as speedily in the one case as the other, though the miners would have less danger in escaping to day when they reached the bottom of the third shaft. There is only absolute safety when the second opening is the downcast, or if the upcast when other means of producing a current of air are applied than by the furnace.

The Weathersfield mine is opened at the end of an old abandoned mine, whose pillars are withdrawn, and which has fallen in, in many places, to the surface. In wet weather the old works are filled with water, but they are dammed back from the working mine by a strong wooden dam, built in the form of an obtuse angle, to resist the pressure of the water. Some of the miners expressed alarm for their safety in case the dam should burst; but a careful examination of the work showed that there was no danger from it. There might be danger from holing into the abandoned mine filled with water, and this proves the necessity of preserving the maps of abandoned mines. There is no map of the old mine in existence, so far as I am aware; but the long, serpentine swamps in which the coal lies lead the new workings away from the old ones, and a horse-back, whose course is well understood, serves as a sort of boundary, or separating line. I take pleasure in saying that the general superintendent of the mine, Mr. Card, as also the mine boss, Mr. Thomas Morris, were alike desirous of making every thing safe, as the law requires. Mr. Morris contended for construction of a traveling-way, in the form of a slope, for the ingress and egress of the miners.

Having been requested to visit one of the mines of Jackson county, I passed a week there about the last of April and beginning of May, and examined all the shaft mines of the county. All the mines in the neighborhood of Jacksontown are opened on the lower coal, the equivalent of the Mahoning valley coal. The mines are all shafts, but none of them exceed ninety feet of depth. Little of the coal is shipped, it being mainly used in the furnaces at home. In none of the mines were there more than thirty-five men at work, and all of them were well opened out. In every one there were ladder-ways for the men to get out and in at pleasure, and all have two or more openings. They were all in good order. The miners blast the coal.

The Milton shaft, eighty feet deep, three miles from Hamden, and twelve miles from Jackson, a new mine, had but one opening, and the miners were afraid of fire. The stalk of the engine-boiler on top was placed too near the engine-house for safety; a mistake made at most new works, and for which more than one company has had to pay, in the destruction by fire of all the wooden structures around and on top of the shaft.

The coal of this mine is higher up in the measures, answering to the Hill coal of the Geological Survey. The floor of the seam is more even and regular, and the entries of the mine were made straight and double, so that ventilation may be made good at all times.

I find that by giving a detailed description of the condition of every mine, the report will be made unusually long. As it will serve the purpose of the law to give a mere general statement of their condition and manner of working (for in many cases one mine is so nearly the counterpart of another that it is mere repetition), I will only go into details in cases where improvements are provided or are in progress, as to mining and ventilation, or in the application of machinery.

I made several visits to the Sodom slope, for the purpose of making experiments in splitting the air, and latterly because of complaint that the ventilation was defective at the working faces. The air of this mine was split into two streams; by measurement it was found to equal 6,680 cubic feet per minute as it passed along in one current, and 9,558 cubic feet when divided into two currents, the larger stream measuring 5,770 feet, and the smaller one 3,780 feet. There was no regulator in use, and the division was suggested more as an experiment than otherwise. Its results were so satisfactory that it was retained as an improvement.

Immediately after the act went into force regulating mines and mining, this company went to work and applied a speaking tube in the slope, but it was found defective in practice; the human voice could not be distinctly heard and understood. The size of the tube was one inch diameter gas-pipe; the length of the slope four hundred and twenty feet. Having allowed reasonable time to all the coal companies to provide tubes, and finding that they were neglecting to do so, I notified the more prominent operators of the Mahoning valley last September to have them put in.

Inch gas-pipes will not serve any purpose at depths below two hundred and forty feet. In the anthracite mines of Pensylvania galvanized gas-pipe is used. For depths of four hundred feet, tubes of two and one-half inch diameter are sometimes applied, but two-inch pipe is more generally applied, even to depths of six hundred feet. Smoothness of surface decides the power of carrying sound, for friction hinders its passage, as it hinders the passage of water or air. In England gutta-percha tubing is in use, but it is very expensive. All the mines of Ohio can have suitable speaking tubes fixed in shafts and slopes by applying two-inch galvanized gas-pipe.

On my last visit to the Sodom mine, on finding defective ventilation prevailing, I notified the lessee of the mine, Mr. Dan Smith, of the fact, and requested an improvement in the air. Mr. Smith replied "that he was sorry to state that he differed with me on this point; he always took a great deal of interest in the working of the mine, and there had not been a single instance of a miner losing a day on account of bad air, while the air-courses are always kept up as close as they can be without a great deal of unnecessary and useless expense." I copy this extract from Mr. Smith's letter, as showing the subterfuge by which an evasion of the law is sought. Mr. Smith, who is a practical miner and an experienced colliery manager, ought to know, and *does know*, that the influence of defective ventilation is not direct where there is no accumulation of fire-damp; that while men are losing no time, they may be dying by inches; that they may go in for a few years, working every day, and then die, or become utterly unfit to work in even good air, from the effects of wasted lungs, resulting from breathing an atmosphere deprived of its due proportion of oxygen by the formation of carbonic acid gas (black-damp).

It is no guarantee that a mine is well ventilated because there is a sufficient volume of air going in at the downcast, and passing out through the upcast. There may be many times the amount of air passing through in this manner that is actually necessary, and yet the miners be gasping for breath at the working faces. The distribution of the air is of equal importance to the creation of the current, and no working place is fit for the abode of the miner where his lamp will not burn with clearness, though a perfect hurricane of wind may be blowing along the main air-course all the year round.

Miners may not lose time, perhaps cannot afford to lose time, in a foully ventilated mine, as individuals; and single complaints may be considered sufficient ground for discharge, but nature will break out in time. Miners work on, fearing if they complain they will be told to go elsewhere—to take their tools and leave. They work on, till the power of endurance having become exhausted, they get up a strike for higher wages, or for the redress of some other grievance, real or imaginary, and then the operators lose fifty-fold the supposed "unnecessary and useless expense" of driving air-ways. It is an easy matter to pass along the rooms of a mine in the early part of the day, before the atmosphere has become fouled, but it is not so pleasant to work all day in an entry or room where every afternoon there is so little oxygen in the air that the miner's lamp can only be kept in by being hung on a post, or on the pillar side, with the spout downward.

On the reception of Mr. Smith's letter I wrote him again, to the effect that the air must be improved, and wrote to the owners of the mine, who promised to make inquiry into the cause of complaint, and have it removed. In cases of this character I will always have the air of a number of miners' work-places analyzed, to show the deleterous ingredients of which it is composed, before resorting to extreme measures to have the law in its spirit complied with.

I found that some of the miners of this slope were in the habit of riding upon the loaded cars in coming up the slope. I got the names of a few cases, and notified the parties that all future violations in this matter would be dealt with according to law. This had the effect of stopping a practice fraught with danger only to the workmen themselves, by their own disregard of personal safety.

The Vienna slope (Shoo-Fly), the Love bank, the Halladay bank, the Osburne shaft, and the Burnett slope, are mines controlled by one company, in each of which there is the ordinary bank boss, but the boss of the Foster shaft, of the same company, has an overseeing charge over all, except in the case of the Burnett slope. This plan is prevalent in English mines, the head boss being called the viewer, who is in general cases a person of good education and a practical mining engineer, and whose duties are given to surveying and mapping the mines, and in directing the ventilation. Such viewers are brought up to the work from boyhood, being taken in charge by old and experienced engineers, who teach them from practical, every-day experience, the requirements of mining, etc.

The Shoo-Fly bank needed improvement in its ventilation; it had a badly constructed furnace, which was also too small for the work required of it. The Halladay bank, a new mine, had very inferior means of making wind, there being nothing but an iron basket filled with coal, making scarcely greater heat than an ordinary house grate; but the air was well carried around the mine, and there was no complaint. The company propose to erect a spacious furnace for moving air, to be in operation in the spring. The Love bank and the Burnett bank were opened on the same basin or swamp, and will work through on each other. The Love bank had but one opening, and was aired by a small shaft sunk on the slope, from which a wooden partition was carried to the bottom for the return air. At the bottom of this shaft, immediately on the side of the passage-way of the slope, there was a ventilating furnace; it was more securely constructed than such arrangements are generally, and there was no dread of fire. The Burnett bank, also a slope, had two openings. When communication is made between these two mines it will throw a great part of the workings of each near the main air-passage, and if advantage is taken of the means of ventilation provided, there need be no complaints of bad air in future. The Osburne shaft was sunk at the end of an old mine, since abandoned, and was not as well aired as it should have been. Part of the workings had crushed, the pillars having been left too weak for the support of the superincumbent strata, and a good deal of leakage of the air was had.

I found an exceptionally well ventilated mine in the Tod and Wells shaft. Although this was an old mine, and the air had to be carried through many a devious path in the line of workings, etc., the current was carried along in a strong and vigorous stream, without leakage, and made to sweep all the workings. The boss did not appear to possess any undue intelligence over his brother overseers, but he took pride in the ventilation of the mine. All his movements were of a timely character, in repairing leakages, building and overhauling stoppages. This was one of the very few cases in the Mahoning valley where a sweeping current of air was maintained at the end of an air-course. And all this was done without costing the company an additional dollar for ventilation.

Another mine provided with good ventilation in all its working places was found in the Brookfield slope. This is the most extensive mine of the Mahoning valley. The coal dips away from the slope, necessitating the cutting of drains and the sinking of several pumping-shafts to discharge the waters of the mine. At the bottom of one of the pumping-shafts there is a Cooper steam-pump, with eight-inch barrel and three steam boilers. The heat from the boiler furnaces, the boilers themselves, and the exhaust steam all enter into the work of purifying the air of the mine, producing a powerful ventilating draft; and all this air is well husbanded, and made to sweep the mine, air-courses being driven, in every case, alongside of the entries. In one place in this mine a water-drain is cut, nineteen feet deep, and there is a hill forty-five feet high. The mine is very extensive, having been running for twelve years, and shows no sign of exhaustion. Most of the coal has to be blasted. The coal generally occupies extended plains, instead of being found in serpentine swamps.

There are nearly forty different mines in the Mahoning valley. They were all personally inspected, except such as were idle at the date of visit, and visits were made to all of them. Of those examined of which no mention is made in this sketch, they were found without serious cause of complaint or defects, which, when pointed out, were corrected, or assurance given that they would be corrected.

STEUBENVILLE DISTRICT.

The mines of this district are all shaft openings, and are the deepest in the State. They are opened on the highest seam of the lower Coal Measures—being Coal No. 7 of Dr. Newberry's survey—the first bed immediately below the Pittsburgh coal, from which it is separated by several hundred feet of strata. The coal is usually about four feet of thicknees, though it sometimes rises to six and eight feet; and it thins down to two feet four inches at one mine. The thickening of the coal above four feet is due to the reunion of two coals—a higher seam of from one foot to two feet of thickness uniting with the four-feet bed. At the mines of the Steubenville Coal and Iron Company, located at Steubenville, the upper coal sometimes comes down upon the regular four-feet seam, making it from four and a half to five feet thick. The union is made without a trace of any clay or other parting between them, and is perfect. At other points in the same mine the thin coal diverges upward, till seventeen feet of strata are found between the two coals. Going down the Ohio River to Mingos, three miles from Steubenville, the upper coal is separated from the other by forty-seven feet of strata; while four miles below Mingos, at the Rush Run shaft, the two coals are together, forming one seam of seven and eight feet of thickness. At this mine, as at Steubenville, they sometimes separate and diverge.

I made two visits to the mines of this district, but did not examine all of the inside workings of every mine, some of them being idle at the date of visit.

The Rush Run shaft is two hundred and fifty feet deep, and is operated by a single shaft, there being, as is usual in such cases, a wooden partition in the shaft to form upcast and downcast compartments. The mine is ventilated by furnace power, there being two good furnaces at the bottom of the shaft; it makes fire-damp (as all the mines opened on this coal do) more abundantly than any other district in the State. The workings are well ventilated, and the mine is examined every morning by a safety-lamp before any of the workmen are allowed to go down the shaft. While the mine is working regularly, and the ventilation kept up, fire-damp is seldom seen in the mine, being diluted and carried away by the circulating current of air as soon as it is evolved from the coal strata.

This mine came near being the scene of a fatal explosion last spring. The explosion occurred, but, fortunatcty, there was no one in the mine, the blast occurring at three o'clock in the morning. Early in last May, as two miners were descending the shaft in the cage, a loose mass of rock fell out of the side of the shaft, but, fortunately, missed the miners. In its descent it struck and broke some of the pipes of the pump, and knocked out part of the wooden partition used for ventilation. The mine boss, a man of experience in the fiery districts of the English mines, immediately had the ventilating furnaces put out and all the miners removed from underground. It required a period of seventy-two hours to repair the pumps and ventilation, during which time the air of the mine lay dead, and all the fire-damp of the mine given off in the interval was accumulated below. The furnaces were lit up in the evening.

So abundantly had the fire-damp accumulated, that it returned to the furnace undiluted by the fresh, newly introduced air, and in passing over the fire exploded with great force, dashing out the wood-work of the shaft, and throwing it out of the pit's mouth. The earth shook with the force of the explosion. The mine was set on fire, and descent was made impossible; but as there were only two mules in the mine, it was unnecessary. Safety lay in closing up the mine and depriving the fire of air. This was immediately done, a solid wall of clay four feet thick and perfectly air-tight being built in the shaft. The mine was left in this condition for several months, when, on being opened, there was found no fire below, but so freely had the fire-damp accumulated that the mine was one vast magazine of gas, exploding in the safety-lamp in the shaft at its very mouth.

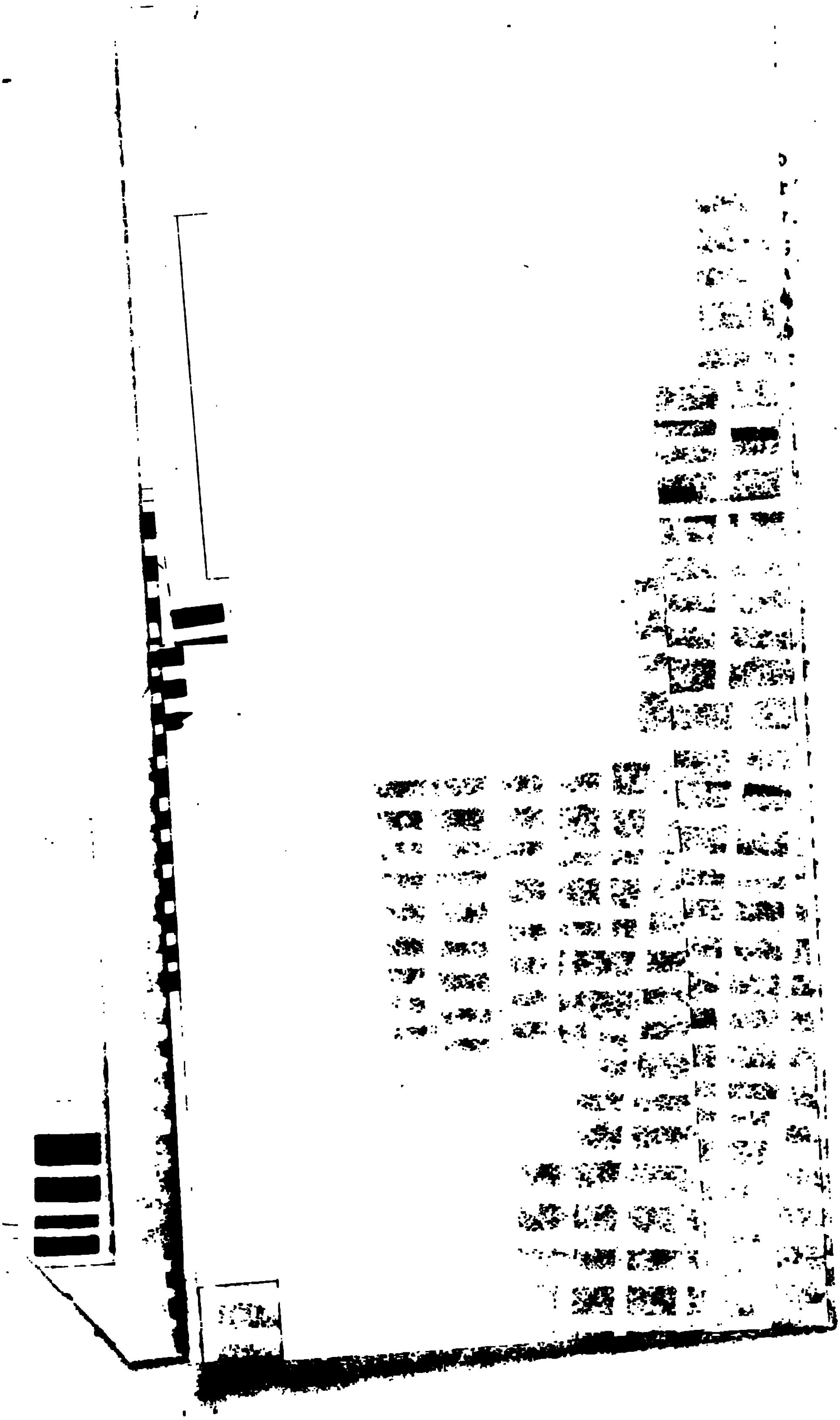
This explosion, although unharmful of human life, shows the danger in risking anything with fire-damp. Though the boss could not believe the fire-damp would return to the furnace at the point of an explosive mixture, it would have been the part of prudence to have had the foul air removed before the furnace was put in operation at all. This could have been done by the application of the waterfall, as water was at hand in any quantity.

The shaft of the Mingo Iron Works Company has very superior arrangements for ventilation, though the shaft, like that of Rush Run, has but one opening. The furnace of this mine is a "dumb furnace," and is so arranged that an explosion of fire-damp by the return current, charged with an explosive mixture at the furnace, can not occur. The return current of air, instead of passing over the fire, is carried above the furnace and delivered into the air-shaft, fresh air from the downcast being carried directly to the furnace to support the combustion of the fire. Had a furnace of this structure been in operation at the Rush Run shaft there could have been no explosion.

The arch of the Mingo shaft furnace is twenty-four feet long, and the fire-arch thirty feet. On top of the shaft there is built a fine brick structure, over the upcast air-way, of six feet diameter and forty feet of height, to assist the ventilation. The inside workings of the mine are laid off with the object of having a full supply of air at the working faces at all times. Every thing is done on approved mining plans, except that a second opening has not been provided, but there have been no returns made for this outlay, for the mine was opened on thin coal, which would not pay the cost of mining. The company have driven in all directions in hopes of finding a thicker field, and at the date of my last visit to this district believed themselves to be on the point of success. As the coal is at least six feet thick at Rush Run, a few miles down the river, and four feet thick a mile or so up the river, there can be no doubt but that better fortune awaits this adventurous and public-spirited company.

The two mines of the Steubenville Coal and Iron Company, at Steubenville, are worked through on each other. The workings of the old mine, the Market Street shaft, are very extensive, and are carried forward on the same system as that prevalent in the county of Durham, in England, the other mines of the district being also worked on the same plan, all the mine superintendents around Steubenville being, originally, miners from that coal district of England. The Market Street shaft and the Stony Hollow shaft are about a mile apart, the former being the downcast and the latter the upcast. Both mines are under a thorough and perfect system of ventilation. There are no complaints of bad air from these mines. The amount of current discharging itself at the furnace was measured and summed up thirty-nine thousand cubic feet per minute. The *air ways are all large* and admit of the easy flow of air.

The last shaft sunk in this neighborhood, that of the Steubenville Furnace and Iron Company, had but recently reached coal, and the hoisting and pumping arrangements were not yet completed. The shaft is sunk on a flat near the Ohio River, and appears to have been put down in the ancient bed of that stream, for though the shaft is one hundred and eleven feet deep, there are only eleven or twelve feet of slate cover over the coal, the other one hundred feet being "drift" material. The coal will, in all probability, dip as the workings are advanced under the steep bluff fronting the Ohio, and cause a great expense for pumping



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and draining. There is a very general rule, to which I have yet seen no exception in the State, that whether a mine be a drift or shaft, or whether it be opened to the dip of the strata or otherwise, if it be opened on low ground fronting a bluff the coal will dip under the bluff for some distance; and this fact should caution the mining adventurer from sinking on such ground. The true plan is to put down a slope, cutting across the strata so as to get the bottom of the shaft well under the bluff, or if the depth be too great to make a slope practicable, then let a perpendicular shaft be sunk as well back on the brow of the bluff as is convenient for delivering and dumping the coal.

There are nine shaft mines in this district, all well ventilated and superintended. The coal lies very flat in the ground, admitting of square and tastful work.

THE HOCKING VALLEY, STRAITSVILLE, AND SHAWNEE REGIONS.

The coal mines of these regions are all drift openings, with two or three exceptions, and they extend over part of three counties—Athens, Hocking, and Perry. The coal ranges in thickness from six and a half to eleven feet. The workings are generally dry, the roof good, and the advantages which nature has provided for producing ventilation have no equal in the State or nation, or perhaps in the world. The country is every where cut up by ravines, which cut out the coal, admitting several cases to almost every mine where entries can be driven out to day, allowing a full sweep of air. The superintendents in charge of the mines are generally men who have been brought up to this kind of mining, and never think of getting air in any other manner than by driving through the hill. It is no uncommon sight to witness a half dozen air entries in a single mine. The air is often allowed to diffuse itself as it pleases, uncontrolled by furnace or other ventilating power, and under no command whatever. Of late years, however, greater attention has been given to ventilation, and some of the mines are now provided with furnaces, and double entries have been commenced to make returns for the air until an opening is reached outside to sweep the mine by a single forward stream.

The mines of Athens county and the Hocking valley are situated on both sides of the Hocking River, on the line of the Columbus and Hocking Valley Railroad, commencing at Haydenville and reaching to Chauncey, a distance of fifteen miles. There are thirteen different companies operating, mining coal from upwards of twenty coal mines. The mines at Chauncey and Salina, both shaft openings, each above one hundred feet of depth, do not ship coal, and employ only a few miners. Both of these mines have been long in operation and are opened in splendid coal.

The shaft of Hamley's Run was examined in the spring by request of one of the miners working there, who complained of bad air, and his complaint was well founded, for there was no proper means applied for getting air into the mine. The workings were nearly new, and there was a partition in the shaft (it had but one opening) for ventilation, and a steam-pump also, the exhaust from which was intended for rarefaction, but the partition was leaking, and the heating power of the exhaust steam too ineffectual for any result. The exhaust pipe, instead of being at the bottom of the upcast, where it would have been of some service, was carried well up the shaft before the steam was discharged. I suggested the closing up of the leaks in the partition and the discharge of the steam at the bottom of the upcast as an improvement, until an air-shaft was sunk, the sinking of which was then in contemplation.

This shaft is sunk in low ground, in what must have been at one time the bed of the Hocking River, for there is no roofing, except a few feet of soft and rotten shale, over the coal, while the shaft is sixty-five feet deep. It is sunk on the high ground of the coal (which dips off under the hill), and has caused a great waste of money pumping and bailing water. New mining operators are tempted to choose the low ground on which to sink, as it is the most promising to view; but the practical miner, acquainted with the inequalities of the coal floor, and of the fact that the dip is always under the bluff, would advise against choosing such a place, as fraught with expense to the mine after the coal has been reached.

All the mines above this shaft on the Hocking River are level-free, and are drift mines, the rise of the coal being south and west. The mines are all provided with two openings, and, in general cases, are well ventilated. Sometimes the workings of a butt entry are suffering for want of air, because the entry has not been got out to daylight. In the mines where the conditions are against getting through the hill before the air becomes too foul for work, an air course is driven from one butt entry to another for a circulation. By driving double entries there could be fresh air kept up to the faces all the time, and there would be no more cost in driving two entries on parallel lines than in driving an air-course, which is simply an entry costing the same, if not more, money—for men must be paid extra for working in bad air so far in the fast.

The mines of W. B. Brooks & Son, particularly those on "Section 19," in Hocking county, were in most excellent order for getting air along. There are seven different openings from which coal is hauled, four of which are opened in the butts of the coal, and all are driven out through the hill. The other mines have each air-passages directly forward. Nature has done every thing which the hand of man could desire to assist the practical miner, and it is gratifying to see her advantages taken, for all these air arrangements have been made with prudent forethought, and with the desire of having every thing in accordance with approved mining experience. So complete are the arrangements for mining and shipping coal of Messrs. Brooks & Son, that two thousand tons daily could be sent to market were a call made for the amount.

During the progress of the miners' strike of last spring in these regions, a band of miners, fifty or sixty in number, conceived the idea of opening a mine of their own on a sort of co-operative plan. With this object in view, a company comprising fifty-seven members was organized on the 9th of July last, under the name of the Nelsonville Mining Company. Each member took one share of five hundred dollars. They leased an eighty-four-acre tract of coal land just below the village of Nelsonville, and forthwith commenced operations, having elected John F. Welch president and superintendent, and A. Poston treasurer. By the 13th of August they commenced shipping coal by canal, and by railroad on the 29th of the same month, having built more than a half mile of railroad, with an embankment averaging six feet high, building also a very substantial bridge over the canal. At the time of my visit to the mine in last October, the company was shipping one hundred and eighty tons of coal daily, and were increasing their trade, having more orders than they were able to fill.

The mine is opened up in approved manner, and the workings have been advanced with skill and prudence, communication having already been provided with another mine for ventilation. It is to be hoped that this enterprise, so auspiciously begun, will prove a success. Many movements of this character have sprung up among workingmen in various places in the Union, most of which have ended in failure for want of business ability to guide and direct the concerns, and because of an unwarranted spirit of fault-finding among the mass. The following is the form of lease of this company:

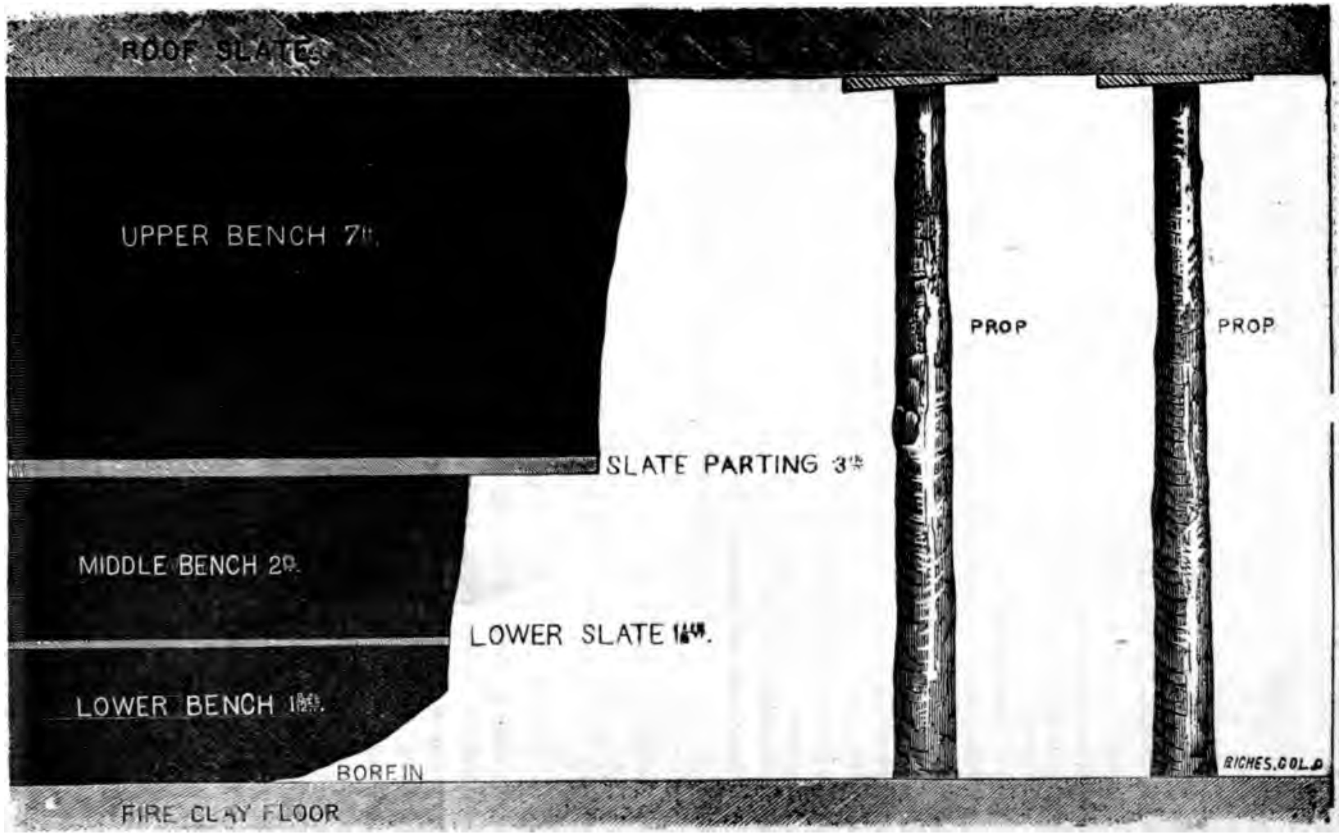
THIS AGREEMENT,

Made and entered into this ——— day of ———, A.D. 187 , by and between Ashford Poston, Charles Robbins, John F. Welch, and William Poston, all of Nelsonville, Athens county, and State of Ohio, parties of the first part, and ———, party of the second part:

Witnesseth, That the parties of the first part, for and in consideration of the covenants and agreements hereinafter mentioned, have let and leased, and doth hereby let and lease, unto the said party of the second part, heirs or executors, for mining coal for ten years, more or less, until the coal therein is all mined and exhausted, the equal and undivided one hundredth (100) part of that eighty-four-acre lot of coal land, being a subdivision of the Watkins lands adjoining the village of Nelsonville, and recently purchased by the said parties of the first part from E. H. Moore and others, of Athens, Ohio, together with the right of way for shipping coal to the canal and railroad, and all the timber on the premises necessary for bank use, track, screen, hoppers, etc. The share hereby leased and conveyed, with the privileges attached, valued at five hundred dollars, and the said parties of the first part hereby agree and bind themthemselves to the party of the second part that they will each take a like share, and will each do, and perform, and be governed in all respects according to the obligations and covenants herein imposed upon the party of the second part. In consideration whereof, the party of the second part hereby agrees and binds himself, his heirs, executors, and assigns, to the said parties of the first part, that he will commence work on the premises immediately; he will work faithfully and to the best advantage in opening and preparing the track, screen, hoppers, etc., at two dollars per day, until mining operations shall commence, and thereafter to mine the coal in a proper and skillful manner, and to deliver the same into boat or car, as the case may be, for whatever is or may be the ruling price for digging coal in the valley at the time; to pay to parties of the first part sixty cents per one hundred bushels of coal, rent for all the coal mined under this lease; to mine and take out the full proportion of four hundred thousand bushels of coal the first year after mining commences, and of five hundred thousand bushels each succeeding year during this lease, according to the number of leases taken; to settle and pay the rent each and every thirty days, and if not paid within ninety days this lease shall be forfeited; and to leave in the hands of the treasurer of the company fifty per cent. of all wages accruing to said party of the second part under this lease, until the five hundred dollars is paid, or until the mine is out of debt and self-sustaining, and such per cent. thereafter as may be agreed upon by the parties at interest, to defray contingent enpenses; and not sell or transfer this lease without permission given by a two-thirds vote of all the parties in interest who may be present at a meeting for that purpose, after due notice given. It is further agreed by the parties, and made a part of the contract, that no rent shall be charged for entry coal, where the entry is nine feet wide or less, and that all the parties to this contract shall share equally in all the profits and losses of this mining association, according to their respective interests therein, and that all moneys, property, or fixtures belonging to the concern at the end of this lease, except the real estate, shall be equally distributed in like manner; and that if the party of the second part shall at any time fail or refuse to comply with any of the provisions of this lease, or to perform any obligation or any covenant herein expressed or provided, such failure or neglect, unless clearly providential and unavoidable, shall be a forfeiture of this lease, together with all privileges, payments, or emoluments arising therefrom.

This lease is not to be construed to inclue any of the surface except what will be necessary for hoppers and tracks.

In witness whereof, the parties aforesaid have hereunto set their hands and seals the date above written.



SECTION OF STRAITSVILLE COAL.

EXPENDITURES IN OPENING THE MINES.

Railroad iron, frogs, switches, etc	$2,565 58	
Trails, spikes, etc., for same	931 65	
Screen-irons, etc	348 30	
Freight on iron, etc	186 60	
Total cost of iron		$4,032 23
Grading, as per contracts		1,108 30
Cost of railroad cars	$6,000 00	
Cost of bank and canal cars	1,521 27	
Total cost of cars		7,521 27
Building canal bridge, as per contract		350 00
Wire rope, windlass for bridge		101 40
Timber and lumber, as per various bills		553 90
Engineering		30 00
Railroad ties bought		75 00
Brick, and work on scale pit		202 30
Hardware bills		160 60
Track scales		1,100 00
Labor of men and teams in July	$1,678 00	
" " " August	1,181 00	
" " " September	486 50	
Total cost of labor		3,345 50
Total cost of construction		$18,580 50

The mines of the Straitsville district are opened in the same seam of coal as that of Nelsonville, but it is several feet thicker at Straitsville, averaging fully ten feet of minable coal. The same surface conditions—admitting of the mines being driven outside to day on several entries—exist here as at Nelsonville; and all the mines which have been in operation for any length of time have several ways of entrance and exit, besides the main traveling and hauling road. There are artificial means employed at one or two mines for moving the air: the mine of the Straitsville Coal and Iron Company, the Troy mine, having a good furnace; and the Central mine, of the Straitsville Central Mining Company, being supplied with the heat of a steam boiler, and the exhaust steam from a steam-pump placed at the bottom of the air shaft. All the other mines rely on the natural forces for ventilation. The air of these mines is not always good, particularly in the working places opened on the line of the "blind" or "dark" entries, that is, those entries which have not yet been got through to day. Several air-shafts have been sunk to blind entries for ventilation in some of the mines; sometimes there are two air-shafts found along the line of one entry. It is easy to have good air in all of these mines, as the working places are high and wide, admitting of a large column of air to the mines, which, even with a slow-moving, or nearly stagnant, current takes longer to foul.

At Shawnee the mines have been opened up within a year or two, and are not far advanced with their workings, but all of them have two opening or outlets, some one of the entries, as at Nelsonville or Straitsville, being driven "to day" on the flank of a hill. The coal is of the same character as the Nelsonville and Straitsville coals, and is the same seam. On the east side of the village of Shawnee the coal is somewhat thinner than on the other side. This appears to be due to erosion. At the mines of the McEwing Salt and Coal Company, four miles above Shawnee, on the line of the Baltimore and Ohio Railroad, the coal is only four feet thick, and appears in a natural state, as though that were its full growth—the upper seven feet being wanting. I incline to the opinion that the "great vein" is the union of two seams of coal, whose equivalents are found at New Lexington, and at many points in Muskingum county, and elsewhere, though it is no unusual thing for a single coal-bed to rise in height from four to eleven and twelve feet. Where the point of divergence begins (if it be the union of two coals) will be discovered as the mines are developed.

The Steubenville coal, which is the equivalent of the great vein of Perry county, owes its increased thickness at the Rush Run shaft, where it is eight feet high, to the union of two coals, which at the LaGrange shaft are eighteen feet apart, at the Mingo shaft are forty-seven feet apart, and at the Steubenville Coal and Iron Company's shaft are sometimes together, and sometimes they diverge for seventeen feet within the compass of one hundred acres. When they come together they form one seam so perfectly as to defy one to point out the place of union.

THE TUSCARAWAS VALLEY.

In naming the different mining districts of the State, I am following the practice of the miners, who in their union have divided up the State into a number of districts, classifying or ranging all the mines of certain counties into districts, like the States of this Union.

The Tuscarawas valley includes all the mines opened on the lower coal bed of the State—the equivalent of the Mahoning valley coal—in Wayne, Stark, and Summit counties. Nearly all the mines of this valley are shaft openings, many of the shafts sloping as in the Mahoning valley. The shafts are not so deep, however, the deepest—the Aberdare shaft—being only one hundred and sixty-five feet of perpendicular depth. The coal presents the same kind of irregularity, lying in hills and hollows, but the swamps are much broader, and the coal area more extensive.

Nowhere in the State has there been so marked an improvement in mining—that is, in laying out the workings of the mines and in ventilation—as in this valley during the past two or three years. All the older openings, with few exceptions, were rudely opened and poorly ventilated; nearly all the newer ones are carefully opened and much better aired. A more intelligent class of underground bosses appear to have got charge of the mines than formerly; and, while making money for the company, have increased the comfort of the working men.

The mines of the Crawford Coal Company—two in number, a shaft and a slope—are ably managed. In each mine a ventilating shaft is sunk in the lowest available place of the mine, and instead of a furnace there is in place the boilers and steam-pumps for discharging the waters of the mines, the heat from which causes the movement of a powerful current of air. By this arrangement the cost of constructing and attending the ventilating furnace is avoided, and the same--in fact, better—ventilating results are attained. The mines of the Brookfield Coal Company, in Trumbull county, have been ventilated in the same manner for some years.

The workings of the slope, as also the shaft, where the conditions are practicable, are opened by driving double entries on every gallery, by which means the air is always kept forward to the face of the entries. Both of these mines were well ventilated.

The miners in both of these mines, and, as I subsequently observed, very generally throughout the whole of the Tuscarawas valley, rely more upon powder than picks for mining the coal. In the great majority of cases no undercutting beyond the mere scratching of the coal face was done at all, but an enormous drill-hole, from seven to nine feet in length, was run into the coal, angling across the face, so as to give the powder its greatest opportunity, and about one-third of a keg of powder inserted at the end of the hole. The miners are permitted to fire but once a day—at four o'clock in the afternoon. On the day of inspection of the slope one hundred and forty men and boys were employed inside the mine. I passed over the hill beneath which the excavations were being carried forward, at the hour of firing, and though there were fully three hundred feet of strata between the miners and the surface, I could hear the report of their discharges quite distinctly, and the earth itself shook with their force. Sixty-five shots were discharged within four or five minutes, and twenty kegs of powder burned.

This method of shooting out the solid causes a great waste of coal, and is a source of annoyance to the operators, for the round coal is so shattered by the shot that it breaks up and will not bear transportation. The miners, however, have found out that it gives ease to their bones in mining, and refuse to quit the practice. They say the coal companies are to blame for its inauguration, as during a long strike new and inexperienced hands were placed in the mines who could not make good coal, and if they would take bad coal from such diggers they must take it from the old miners too. It should be added that the undercutting is very hard and laborious work, which invites the miners to blast out the solid; but it is none the less a mistake and a wrong to waste and unfit coal for transportation by an indiscriminate use of powder.

The mine of Maple Grove, owned by James Mullen, Esq., was examined at this time, August 7. The underground workings were very extensive, and nearly all the coal is blown out of the solid. There was not power enough to ventilate a mine of such extent (it had a force of one hundred and ninety-four men and boys employed) in the ventilating arrangements provided—particularly so where so much powder is used—and there were complaints of bad air; and the arrangements, such as they were, were interfered with by the mine boss, with the best of intentions, however. He had drawn the wooden box which was placed over the top of the upcast shaft to a point only half the size of itself and the ventilating shaft, and had also placed an iron shade before the furnace to narrow down the size of the air-passage, to make the furnace "draw"—both arrangements serving no purpose but to obstruct the current of air and lessen its volume. I have met several underground bosses at the same practice.

The miners at this mine at the time of my visit were also striving to keep the air bad. At the head of two butt entries which had been driven into thin coal, whose rooms had no return air-passage, the boss had started an air-course to cross from one entry to the other, to get up the air, and he could not prevail on any of the miners, with the powerful argument of a superior price added, to drive forward this air-course, because, as they alleged, the "bottom" was not being cut out with the coal. Little cars were to be used to get the coal forward to the main roadway, whose introduction they claimed would be the signal for their general introduction in the mine, which they would never permit. I talked to some of the more intelligent miners of the folly and injustice of such action, and the opposition was promptly withdrawn, and the air-course allowed to proceed. Miners are perfectly justified in looking after their rights and in combining to protect themselves from the encroachments of employers, but it frequently happens that they encroach upon the rights of others, and this was assuredly a plain case of that character.

The Jacobs shaft, of the Rhodes Coal Company, was opened on a model plan, and although the ventilating arrangement was faulty, consisting of the exhaust steam from a steam-pump, to produce rarefaction of the air, the air of the mine was above complaint. The mine extends from both sides of the shaft along the face of the coal, and the entries are double. The butt entries, driven at proper intervals to open up space for the rooms, are also double, and all the air of the mine was made to sweep the face of the entry faces, and, consequently, to diffuse itself through the roome in healthy streams.

The mine of the Massillon Coal Company, although an old work, and badly riddled, was found in good order; the stoppings were all made air-tight—and securely so—by a wall of wood, against which the gob *debris* was thrown and packed. The air was sent forward to the faces, and a good current prevailed, there being a roomy furnace at the bottom of the upcast. The mine boss was a young man but recently put in charge of the work, in the reconstruction of which he displays good ability.

There are a number of mines near Canal Fulton and Chippewa which were examined. Some of them were not in that degree of safety, as regards the life and health of the miners, as the law provides; but they were being rapidly exhausted—a few months would close them up—and it was not deemed advisable to order new and costly mining fixtures under such circumstances. The managers and men were cautioned against thoughtlessness, and asked to use care and diligence until the places would become wrought out.

I visited the mines of Summit county in the early part of November. The mine of the Middlebury shaft is not provided with safety-gates nor safety-catches, and there was but one cover, or rather the half of a cover, on one of the cages. The landing at the shaft top is double, which will make it inconvenient for vertical safety-gates; but horizontal ones covering the shaft-mouth might be fixed up to serve every requirement of the law and make the opening safe. The ventilation of the mine was good. I notified the company of the requirement of the shaft, and as the superintendent is a man of skill and an experienced practical miner, I think he will find no trouble in getting every thing made right.

The other mines of this county were slopes and drifts, except the Johnson shaft. They have all been fortunate in their operations this year, not a single accident, fatal or serious, having been reported at any of them. The ventilation was found above complaint.

THE POMEROY DISTRICT.

The Pomeroy coal region extends along the Ohio River in Meigs county from Racine to Silver Creek. All the mines are opened on one seam of coal—the equivalent of the Pittsburgh bed. The coal ranges in thickness from four and a half to five and a half feet, and dips to the east at the rate of about thirty-two feet to the mile. At Pomeroy the coal is forty feet above the bed of the Ohio River at high water. At Minersville, three miles up the river from Pomeroy, the water at its highest stages flows back into the mines. At Syracuse, two miles above Minersville, the mines are shaft openings, and the Antiquity shaft, near the village of Racine, is two hundred feet deep.

The Antiquity shaft, at the date of visit to this district, was running with only four or five men, and was not inspected. It is a single shaft, but I learned that the proprietors have under consideration a proposition to sink another one, in conformity with the requirements of the mining law. The mines at Syraccse, two in number, one a shaft and the other a slope, have each double outlets, and are also holed through to each other. The mines were in good order, so far as the ventilating arrangements were concerned, but at the shaft there were no covers on the cages nor safety-gates on top at the landing of the cars. I called the attention of the superintendent of the mine to the requirement of the law in the matter, and he sent the carpenter of the mine to me for instructions as to the manner of applying such fixtures, and promised to have them provided as soon as possible. The catches on the cages had been in use for a number of years, and in my judgment needed renewing. There was no good way to test their value without stopping the mine for some hours. They had been put to the test once, some years ago, and proved to be a safety-catch worth having. As one of the miners was coming up the shaft on a loaded car the rope broke, but the catches held the cage suspended in the shaft and saved the miner from death and the cage and car from being dashed to pieces.

The miners of this shaft were, up to the time of my visit, in the habit of riding on loaded cars, and of crowding themselves on the empty cages to the number of sixteen and eighteen in going up and down the shaft. I directed the cage-man at the bottom of the shaft not to allow any one to ride on a loaded cage under any pretext whatever, and to let no more than ten men on an empty cage at once; and I also notified the miners that any future violation of these rules would not be tolerated.

The mine of Ebenezer Williams, the first drift opening of this district, was exceptionally well ventilated, there being two hundred feet of air per man per minute traveling through the mine and distributed through the workings. The miners blast at all hours of the day, a practice I have every where discountenanced, and it is now very generally forbidden throughout the State. There is no excuse for it in any mine in the State, for the workmen in the rooms—all working single—if they make their coal ready as it should be made, need fire but once a day, and the proper time for that is at quitting time, so that the smoke may escape after the workmen have withdrawn. No matter how well the mine may be ventilated, where one hundred or more shots are fired in a day, consuming from six to twelve kegs of powder, the air will be vitiated and unfit to breathe if this subterranean artillery is allowed to roar during working hours at the pleasure of the miners.

The mines of the Pomeroy Coal Company, six in number, all drift openings, were in good order. Some of the miners complained to me of bad air in part of the Pamunky bank. On the day of inspection the mine was idle, and the ventilating furnace was out. The arrangements for ventilation for workings of its extent were ample enough, but the mine is an old one, and its foul air from the waste-workings was allowed to diffuse itself with the circulating current to some degree of insalubriousness.

The mines of this company, and all the other mines of this region, are ventilated on the double-entry system, an arrangement which consists in driving all the galleries double, a pillar of a few yards of thickness being left between them, which is holed through every forty yards, and then closed up as a nearer opening is made. The rooms are also cut through from one to the other every forty yards, so that, when proper care is taken, the circulating stream of air (the whole current of the mine) is made to sweep past in this manner, making the working places fresh and sweet.

Greater attention to ventilation has been given of late than formerly, and the miners were grateful for the improvement. The system of ventilation by double-entry driving, though long adopted by this company, having been put in practice by the engineer of the mines, Mr. Heckard, before it was thought of in any of the other mining regions, needs care and attention as well as other and more faulty systems, for stoppings will leak, badly hung and broken doors will spill air, air-courses will become partially choked by mine-rubbish and gob-waste, and the mephitic air from the waste-workings will find its way to the rooms mixed with the circulating stream, unless daily care is practiced.

The double-entry plan of carrying air through a mine, as adopted by this company, can be made to serve every purpose of the law, and will sooner or later be practiced in all the coal regions of Ohio. The old plan of driving forward a single entry, until the miners can no longer live or their lamps be made to burn, and then coming back and driving up an air-course, not abreast of the entry, but far behind it, so that the miners ahead of the air-way are forever living in a stagnant atmosphere, will not be wise, nor expedient, nor possible under the present law. Although the law wisely forbids any interference with the management of the mines by the Inspector, its demands for adequate ventilation will compel owners and superintendents in self-defense to adopt double-entry ventilation.

There is continual peril from falling material along the main entries in every mine of the Pomeroy region. The shale above the coal readily decomposes by exposure to the air, and it is daily falling, till, in some places, the entries are twenty feet high.

BELLAIRE REGION.

The mines of the Bellaire region are opened on the same bed of coal as that of Pomeroy, being the Pittsburgh coal. The dip of the coal is down the river. At the Belmont works, near the village of Bellaire, the coal is level free. At the Pittsburgh works, a mile below the Belmont mines, it has to be sunk for. At Weegee and the Union Coal Company's mines it lies still deeper, proving that the basin of the Alleghany coal field, instead of being at Wheeling, as the older geologists hold, is between Bellaire and Pomeroy. The coal dips below the bed of the Ohio at Weegee, and is never seen above it again till Minersville, in Meigs county, is reached. The lowest place may be further east in West Virginia, but it is assuredly not at Wheeling, nor in the near neighborhood of Wheeling.

The Belmont works of Heatherington and Brothers were in a very praiseworthy condition in all their arrangements, and particularly so in the ventilation department. The mines, two in number, are drift openings. The upper mine was driven through the hill. From this second opening the intake air was drawn, and sent around the working faces in a pure and vigorous stream, before it became mixed with the foul air from the old abandoned workings. A good furnace and upcast shaft were provided, which had been constructed since the passage of the mining law, the older ones having been torn down. The lower bank was equally well ventilated, and a passage-way from one mine to the other, nearly completed, would soon give double means of egress to both mines. The working places of the miners were dry and comfortable, making a most inviting place to toil.

The Pittsburgh works of Messrs. Rockinghauser and Sterritt are reached by a short slope. The mines have two openings, but the mouths of both are nearly together, and do not meet the requirements of the law. The proprietors are driving an entry, so they informed me, to reach a point where they propose to sink a new shaft, but they feared they could not reach it to complete the work by the 21st of March next, when the law requires the openings to be completed. The general manager, Mr. Rockinghauser, hoped that an extension of time would be granted. This no inspector can do, the duty of such officer being not to set the law aside, but to see its requirements enforced and obeyed.

The Weegee mines were not working on the day of visit, and the Empire mines had been stopped for many months, and neither of them were inspected. There are also many other mines in this county which have not yet been examined. Most of them are drift mines, and do not work many men; they will all be visited in time.

The coal of this district is nearly six feet in height, of good quality, though inferior to the Monongahela coal, near Pittsburgh. The working places of the miners are generally very dry; and, with good air prevailing, are comfortable and healthy.

Several holes have been bored in this neighborhood, down through the Coal Measures into the Waverly sandstone, and at Pomeroy there has been a great number of salt wells bored to a depth of from 900 to 1,100 feet; but, unfortunately, no correct journal of the measures appear ever to have been taken. Both at Bellaire and Pomeroy at least two workable beds of coal have been pierced, but no two drillers could report the same facts as to their thickness and depth below the surface. The borers were looking for salt and oil, not for coal, and living in a region where inexhaustible beds of coal, so to speak, crop out from every hill-side, they had no inducement to look for coal. There should be, and there doubtless is, from four to six coal seams of good mining thickness below the Bellaire and Pomeroy coals.

THE SALINEVILLE DISTRICT.

At Salineville, in Columbiana county, an important mining district has been developed. The mines are opened on two different seams of coal, known locally as the "strip vein" and the "big vein." The strip vein is usually about a yard in thickness; the big vein varies from four to seven feet in height. They are separated from each other by strata of shales and sandstones, varying from thirty-one to sixty-two feet in thickness. The big vein is doubtless the equivalent of the Steubenville shaft coal, the great vein coal of Perry county and the Hocking valley, and the Cambridge coal of Guernsey county; and the strip vein the equivalent of the upper seam of the lower Sunday Creek, and of the thin coal which overlies the Steubenville shaft coal.

The dip of the coal is more rapid at Salineville than any where else I have seen in the State, being from fifty to sixty feet to the mile. Both coals have local swamps, which make the dip still more rapid in some places. The swamps do not appear to lie immediately above each other, hence the difference in the thickness of strata which separate the seams at certain points. The measures dip to the north-east, this district being situate upon the flank of an arch or anticlinal, such arches being frequently met with, making the dip run counter, for some miles, to its true line of direction.

The upper coal is the more valuable of the two, and though costing more to mine by pillar and room working, could be got by long-wall working fully as cheap as the big vein. Both seams are well adapted to the long-wall system, but in the small vein all the rubbish and gobbing could be got at hand in the mine. Both seams have fine roofs, making the work very safe for the miners. Only one serious accident was reported from this district. That was caused by the sudden falling out of a "coal pipe" or "bell mound"—the cast of a tree of the original coal forest—upon a miner at the face of his room. In a great number of working places the rooms were without a single prop, the roof the while ringing as hard as metal. The workings are dry and comfortable, and all the mines are drift openings. Great and most inexcusable neglect, however, has been given to ventilation. The mines make no fire-damp, and little—less than any other region of Ohio—of any other mineral gas; but the coal of both seams requires the use of powder, and so weak are the currents of air of many mines that the smoke hangs all day in the mine in blinding and suffocating volumes. This is the general, though not the universal, rule, for I found some mines in a good state of ventilation, one deserving of mention being the Farmer mine, of the Manufacturing Coal Company. Though this mine had no furnace, the second outlet or air-passage was on ground greatly elevated from the intake, and was at the back of the workings, where it could do most service.

The mines of the Ohio and Pennsylvania Coal Company in operation at the date of visit, two in number—both opened on the big vein—were holed through on each other; they are both drift openings, the entrances being about one hundred and fifty yards apart. There was no artificial means of creating a current of air; and as the openings are nearly on the same level, nature gives little assistance. The workings in both mines were filled with powder smoke, and were no fit place for the abode of miners. The mine superintendent thought the air was good enough because the miners' lamps burned clear, overlooking the fact that the product of explosions of gunpowder form "white-damp," amidst which a miner's lamp will burn with great clearness, even where human life can not exist an hour. This company were driving a place to pierce through the hill, which, when completed, would greatly help the air; but if a shaft were sunk near the outcrop, instead of driving out level, and a good furnace placed there, better service would be secured.

Along the line of the Pittsburgh and Cleveland Railroad, immediately below Salineville, two coal companies are operating, one of which, the Empire Company, were not running at the date of visit, the boiler being out of order. In the lower mine an air-shaft had been recently sunk on suitable ground, at the bottom of which it is proposed to place a ventilating furnace, which will meet every requirement of the law, provided always the current is properly distributed.

There is no excuse for miners blasting at all hours of the day, especially when one shot is sufficient to throw down a day's coals; and this practice ought to be prohibited. The coal mines of Salineville must have better ventilating arrangements and less powder smoke polluting the air, if the operators desire to conform to the requirements of the mining law.

There are a number of mines between Salineville and the Ohio River, most of which were idle at the date of visit. A mine at Hammondsville, a shaft, with proper outlets, opened on the Hammondsville "strip vein," was visited, but was not inspected. The engine and shaft machinery were rude structures, reminding one of the earlier efforts of mining. This coal is the fourth seam below the Salineville "strip vein," and is about thirty inches thick, of admirable quality, but expensive to mine. The cost of mining might be reduced—at least much rounder coal and a greater average could be secured by adopting the long-wall system of mining. At the mouth of Yellow Creek mining has been carried on for years, but at present not very vigorously; every coal region still suffering from the effects of the panic.

COSHOCTON REGION.

The mines of the Coshocton region are opened along the line of the Pittsburgh, Cincinnati and St. Louis Railroad, in Coshocton county. The shipping mines number nearly a dozen, and there are as many others which work a few hands to supply the home trade. This coal, called No. 6 by Prof. Newberry, is very unlike in appearance the "big vein" coal of Columbiana county, the Cambridge coal of Guernsey county, and the "big vein" of Port Washington, its equivalents. It is from two and a half to five feet thick, rising on hills, like the block coal of the Mahoning valley, and growing gradually thinner as it goes up the hills.

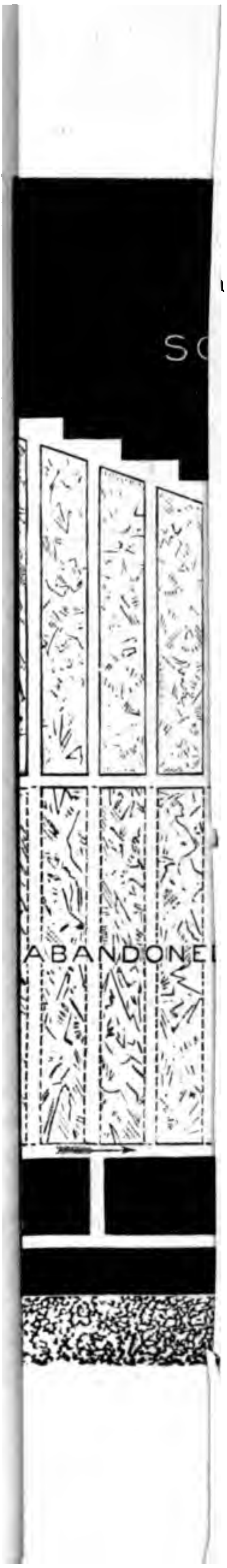
The mines are all drift openings; the mine entries are driven along the face of the coal, from which butt entries are carried to win out the rooms. The system of ventilation in practice is rude and imperfect, consisting in breaking through from one room to another on the left side of the butt entries, and allowing the air to return down the entry. The slack of the coal, containing pyrites of iron, produces spontaneous combustion—"breeding fires"—in the gob, if exposed to water. The heat of the gob raises the temperature of the mine, and its emanations foul the air, recommending more elaborate arrangements for ventiation than are found prevailing.

The Glasgow and Port Washington Iron and Coal Company, whose mines are located along the line of the same road, in Tuscarawas county, work both the big vein and No. 7, the latter being the equivalent of the strip vein of Salineville, in Columbiana county, and the Bailey's Run coal of the lower Sunday Creek, in Athens county. The coal at Port Washington is overlain by a seam of blackband ironstone, ranging from seven inches to thirteen feet of thickness, which yields 33 per cent. of iron in a raw state, and 50 per cent. after being calcined. This ore is similar in character to the famous blackband ironstone of Scotland. The ore is mined in the same manner as the coal—by pillars and rooms. If this valuable stone is found to extend over any considerable area of the coal field, it will raise the iron industry of the State to the foremost rank in the world.

The coal mines on the line of the Cleveland and Pittsburgh Railroad—the branch road from Bayard to New Philadelphia—and those of the Lake Shore and Tuscarawas Railroad, have not been visited, but will be as soon as it is possible to get round to them. They are mainly drift mines, and, except in a few cases, are not very extensively operated; but they require inspection none the less on this account, as small mines are generally as poorly ventilated as those of greater extent.

GENERAL REMARKS ON COAL MINING.

There are two general systems practiced in working out coal, termed respectively the "long-wall system," and the "pillar and room system." Each of these modes are varied to suit circumstances. In Ohio the long-



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wail is nowhere in successful operation, and has only been tried at all at two mines in the State—at New Lisbon and Washingtonville, where it promises to prove a failure in each case. At New Lisbon the roof of the mine is so soft and friable that the roads can not be supported by it; and at Washingtonville the coal can be worked cheaper by pillar and room, because of the cost of maintaining roads.

Where the conditions are suited for the long-wall manner of working (and many districts of Ohio are admirably suited), it has many advantages to recommend its application over any mode of working by pillar and room, for all the coal is got as the workings progress forward; no pillars are left at all, the superincumbent strata being allowed to crush down behind and over the heads of the miners. It is very largely followed in Scotland, more than one-half the coal mined being got by it. In Shropshire, Derbyshire, and Leicestershire, in England, and in great part of South Wales, and also in Belgium and Saxony, it is a favorite method, and is yearly coming into more extended practice. It can be applied with advantage in a majority of mines in Ohio, but its application is limited by circumstances which must be well understood, or the adventure may result in failure.

The pillar and room system can be applied to any seam of coal. All the mines in the State are opened on this plan, and in the majority of cases on the worst modifications of this plan, the object in view being the removal of as much coal as possible as the workings progress forward, leaving pillars of only sufficient strength for the immediate support of the roof. There is nothing to recommend, and every thing to disapprove of, in the systems of mining in general practice in the State. Its original introduction is doubtless due to the necessities of the operators, anxious for as large immediate returns from their mining concerns as possible, and to the thoughtlessness of inexperienced managers, desirous of getting a big name by opening up the workings rapidly. Mines which have been in active operation for years are paying for such folly now in crushed and lost pillars. At the mines near Cambridge, in Guernsey county, all the more extended workings have been lost by creeps, the pillars sinking into the pavement or floor, and closing up the mine. At the old and extensive mines of the Hocking valley nearly all the pillars of the old workings have been left standing, and no attempt is made for their removal; nor is their removal possible, for being left too weak in the first place, the first break which would follow from the extraction of any part of them would extend over the whole mine and crush the pillars to pieces and close the mine forever. In addition to the ultimate loss of coal by leaving the pillars too weak for removal, a great expense is incurred in keeping an old mine in repair—removing fall of roof, keeping air-ways open, and frequently in driving new roadways.

A mine should be worked in squares or panels, and the pillars should be removed as soon as the rooms of a square are diven to the point of destination in all cases, where such conditions are practicable, and drift mines particularly invite such a mode of working. When a crush (or creep) comes, it will be confined to a single division of the mine, and when its force is expended it is forever after powerless for harm. Even when extra strong pillars are left with the view of their removal when all the room workings are finished, the coal is never so good for merchantable purposes, owing to the increase of small coal, as that cut from the new, fresh face. But the better plan of all is the adoption of the long-wall system, by which the whole of the coal is cut away in working forward.

I have elsewhere stated the loss from crushed and abandoned pillars and small coal as being 33 per cent. of the whole in working out coal. This estimate may seem to many persons as extravagantly high, but if we take the system of mining as practiced heretofore as our guide, it will be found to be extravagantly low; and this is true not only of Ohio mines, but of other States as well. In the Cumberland coal region of Maryland, famous for its fine semi-bituminous steam coals, there is a vein of coal ranging from nine to fourteen feet in thickness, which covers an area twenty miles long and from five to seven miles wide, much of it, however, being cut away by the deep erosive valleys which run through the coal field. This coal seam, which twenty years ago was considered as practically inexhaustible, is already threatening exhaustion, not so much from coal actually mined and removed to market as from the wasteful modes of mining. In many abandoned mines, after all the pillars are got which can be reached by the present criminal manner of mining, more than one-half of the coal is left in the mine, and there it will remain forever, lost for all time. Along George's Creek at least five feet of solid coal of magnificent quality, three feet of which is of easy and inviting removal, is left untouched in the mine; and it is a matter of wonder that the operators of the mines will permit this waste, seeing that several of the mines take out all such coal—the Hampshire mine coal, which is fully fourteen feet in height, being all boldly removed except the waste in drawing pillars.

In the anthricite region of Pennsylvania the same wanton systems are practiced. In a work published by Messrs. Daddow and Bannan, of Pottsville—the former a practical miner and engineer of mines, and the latter the talented editor of the Pottsville Miners' Journal—it is stated that, though it is generally understood that two-thirds of the coal is got in mining, not more than one-half is recovered, especially with respect to the Mammoth vein; and the estimate is made that for the two hundred million tons of anthracite coal already mined fully two hundred millions more are left in the mines beyond the possibility of recovery. No such wanton waste ought to be tolerated. It is true, indeed, that nature has blessed our country above all others with the existence of boundless fields of coal, but if the amount were ten times greater than it is it will be exhausted some day, for as an English writer has said of the stores of British coal, "we are drawing more and more upon a capital which yields no annual interest, but once turned to light and heat and force is gone forever into space."

The British people, alarmed at the heavy drain upon their coal fields, and the probable near exhaustion of the coal supply, are actively at work devising improved methods of mining and labor-saving machinery to cheapen production, so that thin seams may be wrought. British coal mines have now become so valuable, by reason of the enormous demand for coal and its growing scarcity, that the main study of the mining engineer is how to produce the greatest amount of coal from a given area. But if the British government, at the time of the discovery of the steam engine, had assumed official supervision over the working of the mines and the management of mineral property, millions upon millions of tons of coal, which have been lost by bad management or by greed for immediate returns, might have been saved to the nation. This right, however, which is clear in cases of mines like those on the continent of Europe, where all minerals belong to the State, may be open to grave doubt in England or America, where all mines are owned and operated by private citizens, but its advantages are none the less sure.

Hon. Charles Reemelin, of Cincinnati, assuredly one of the profoundest thinkers and best informed of our social scientists, in the report of the Ohio Mining Commission for 1871, said:

> "The fundamental right of society to have these minerals, and to have them without avoidable waste and cost, and with scrupulous justice to all—this great right of all the people, both present and future, compared with which all the other little rights dwindle into insignificance, this right Ohio has not surrendered and should not abandon."

If the State of Ohio can not provide for official supervision in the interest of posterity without infringing upon the private rights of property and commercial freedom, it could do much for both present and prospective mining operations by the establishment of mining schools for the education of master miners and mining engineers, a policy which has placed Germany and other continental European nations far in advance of the English and the Americans in the art of mining. In the application of improvements for coal-getting there would also be increased safety to life, health, and limb in the mines; for the united testimony of all mining engineers whose testimony is worth anything goes to prove that commercial prosperity and human safety go hand in hand.

No person charged with the least responsible management of a mine is allowed to assume such charge in any of the continental States of Europe without first having graduated at a mining school and receiving a certificate of competency. In Great Britain, by a recent act of Parliament, all mine managers are also required to undergo an examination before a mining board and receive a certificate of competency.

Many of the government mining schools of continental Europe for the education of the master miners are models worthy of imitation. They are generally located in the very heart of the mining regions, so that miners working in the mines may be able to attend to fit themselves for more responsible positions without having to lose a single day's work. Admittance to such schools is free, the only conditions being that the applicant must have wrought for one year previously in the mine. The students work in the forenoon in the mine and attend the school in the afternoon and evening. They are taught book-keeping, surveying, platting the workings on paper. Chemistry, mineralogy, and geology are also taught. The students are required to work in the blacksmith's shop to acquaint themselves with constructing tools, and to work in new shafts to learn timbering, blasting, etc. It requires three years' attendance to graduate. I have met with a few of such graduates in charge of mines in Ohio.

There were several schools for master miners opened in England some years ago, but they do not appear to have been much of a success.

GENERAL REMARKS ON THE LAW AND ITS APPLICATION TO MINES.

I have elsewhere given my views in regard to the amount of air required for the safe and healthy ventilation of a mine, and have copied largely from the writings of the ablest miners of the age on the subject. While many mines, particularly new openings, may be very efficiently ventilated with a smaller current of air than the law calls for, there can be no mistake committed in having a surplusage of wind. You never hear of a mine, even the safest, being too well ventilated, while there is a crying complaint of defective ventilation the State over, not in every mine, it is true, but in every mining district.

In regard to the safety appliances required, it is not too much to say that the safety-gates placed in front of shafts not only meet the unqualified concurrence of every operator who has found it necessary to apply them, but there is not a mine owner in the State who would now do without them were the cost of their construction four-fold what it is. The same is equally true of covers for cages for the protection of miners against the falling materials in shafts.

The provision requiring safety-springs in front of slopes has not been complied with, for the reason that there is no safety-spring invented which will serve any efficient purpose of safety that I have yet met with. To be of any real value, it must be self-acting, or be under the control of the engineer of the mine. Some mines have springs fixed on the latches of the parting at the brow of the slope to keep the latches in place for the reception of the loaded cars as they come from the mine, and this spring serves as a kind of check on the empty car in its passage forward, and is to be commended as of some value; but the presence of a careful man on top to hitch and unhitch the cars is, in the present order of things, the best safety apparatus of all; and until something of substantial benefit is brought out, this part of the law will remain a dead letter for all practical purposes, and may as well be repealed.

The safety-catches for cages have been very generally applied, the kind in more general use in the Mahoning valley being the patent of V. B. Blair. There are fully a dozen varieties of safety-catch appliances in use in the mining districts of Europe and America, though there are but three distinct types, all of them originating on the same principle, that of a spring and clutch, the spring being kept compressed by the traction of the hoisting-rope, and the clutch pressing upon or into the guides by the rebound of the spring on the breaking of the rope. In the mines of continental Europe, Fontaine's Claw Parachute, among the first of these inventions, is the favorite safety-catch, though there are many others applied. I witnessed the breaking of the two ropes of a mine in Mercer county, Pennsylvania, a few years ago, caused by the destruction by fire of the wooden structures on top of the shaft. Safety-catches, which had been in use for over a year and a half, constructed by D. W. Roy, the manager of the mine, after an English model, held the cages firmly suspended in the shaft for several days, until they were withdrawn. On the completion of the Gould and Curry mine, of Nevada, safety-catches were applied to the cages, and to test their powers the blacksmith who constructed them had the cage loaded with a ton of stone, and then jumping on himself, cut the rope. I have seen at several mines, and also at the hoists of a number of blast furnaces in the State, a patent safety spring-catch, which acted in iron ratchets fastened to the guides, after the patterns in use on the elevators of our large hotels, which were very highly commended by the companies who had applied them. In the mines of France and Belgium the government requires that safety-catches shall be used on all cages which raise or lower men through shafts, and M. Simonin, in his able work on "Underground Life, or Mines and Miners," says that they rarely fail or lose their effect, and that many valuable lives have been saved and many accidents prevented by them. Prof. Raymond, United States Commissioner of Mining Statistics, in his report for 1870, strongly urges their adoption, and mentions a case of the Auzin mines, where in fourteen shafts twenty-nine cable ruptures occurred between the years 1851 and 1859, and the safety-catches saved the lives of one hundred and fifty men.

The mining law of Pennsylvania requires the use of safety-catches. The mining laws of Great Britain leave their use to the judgment of the operators of the mines, and many English collieries, after having adopted them, have had them removed, mainly for the reason that in fast winding they sometimes catch during the surging of the rope, introducing a greater danger than the one sought to be removed; and speed is a necessity and an economy in deep shafts. No kind of catch appears to work well in fast winding, as they all depend upon their action on the springs which are kept compressed by the tension of the winding-rope.

There is danger of their use inducing carelessness of inspection of ropes. If implicit reliance is placed in their application, they may do more harm than good. The power of the spring will weaken with constant traction, just as the winding-ropes break by constant wear. The springs will require to be removed as often as they lose their effect, and it is none the less the part of wisdom to trust to excess in power and strength of cables, even with the newest and most approved catches in use. On this point Mr. Brough, the English inspector of mines, says: "I willingly add my testimony to that of others in favor of the ingenious contrivances displayed in these inventions, but I must observe that the substitution of safety appliances for strong, efficient tackles is by no means true economy."

Speaking tubes have not yet been generally fixed in slopes and shafts where the human voice cannot be distinctly heard and understood, because at first their powers of conveying sound were claimed not to be understood by the responsible parties in charge of such mines. The Sodom mine owners of the Mahoning valley, shortly after the passage of the mining law, applied an inch-diameter gas-pipe to the slope, which is four hundred and twenty feet in length, but it would not convey sound, and was removed. I suggested a pipe of two-inch diameter, which

I would warrant. In the anthracite region of Pennsylvania pipes of two and a half inch diameter are sometimes put in for depths of four hundred feet, but more commonly two-inch pipe is used to depths of even six hundred feet. The pipe is usually galvanized gas-pipe (inside). All the mines of the State can have suitable tubes by applying pipe of two-inch diameter.

The maps of mines have been very generally forwarded to the office, most of them being on a scale of one hundred feet to the inch; a few of them are on a larger scale, the law allowing it; and one or two are on a scale of one hundred and fifty feet to the inch. This is contrary to the requirement of the law, which forbids a smaller scale than one hundred feet to the inch; but the properties of the companies in question were so extensive, embracing upward of one thousand acres of land, that it was found practically impossible to follow the letter of the law. Some of the smaller operators, removed from great mining centers, whose mines have not yet been visited, have failed to send forward maps up to the present time.

The law is defective in several important particulars, and requires amendment to make it effective. The section forbidding boys under twelve years of age, and under sixteen unless they can read and write, from working in a mine, makes it the duty of the superintendent to see that it is not violated, but there is no penalty attached in case the superintendent disregards this requirement of the act. I am glad to see, however, that notwithstanding this defect most of the managers have enforced this provision of the law, and it has had a very noteworthy effect. Night schools have sprung up at a very large number of mines, and not alone those boys attend whom the law has ostracised, but nearly all other boys as well, and in some cases the father also is a regular attendant. The law is also defective with respect to reporting accidents, both serious and fatal, there being no penalty attached for failure to comply with it in this particular, and more than three-fourths of the fatal accidents were not only not reported to myself immediately after their occurrence, but the coroner was not notified. The responsible parties having charge of mines do not care to report such cases, even when no blame attaches to their management, because the recurrence of mine casualties are always thought to reflect against the mine and its management. There is also a defect in the case of bosses reporting the amount of air in circulation. I believe it would be well to require all mines to make monthly reports of the air to the Inspector of Mines.

The law should be amended also so that fine and imprisonment would attach to managers or orperators for willful failure to comply with its provisions which have reference to ventilation or to applying safety-gates, covers, and catches for cages, and speaking-tubes. As it now stands, the remedy is in prohibiting the working of the mine with more than ten men until it is made to conform to the requirements of the act; but such prohibition, more particularly in times like the present, when work is so scarce, might entail untold suffering upon many innocent families, in the loss of work consequent on the stoppage of the mine. Besides, the law may be violated every day with impunity in one of its most essential particulars, that of ventilation, by willful neglect of the furnace, or failure to provide doors and stoppings at the suitable date; and by the time the court could reach a decision in any case every thing could be made right, and before a month had elapsed the mine might be in as bad a state as ever. Indeed, the furnace may be neglected every day, and *is* neglected every day in many mines, causing defective ventilation, to the injury of the health of the underground workmen, and there is no remedy; but if punishment by fine and imprisonment were visited, such neglect would cease forthwith. Where there is positive and immediate danger of the destruction of the whole force of a mine, as, for example, where there is but one opening provided, the law ought not to be changed under any circumstances of the case.

It will be seen in reading over the list of serious accidents and their causes, that quite a number of them have occurred in slopes by cars running away. I would recommend that all slopes be required by law to have suitable traveling-ways provided on one side of the track, at least two feet and a half in width, and that man-holes, capable of allowing of the entrance of three men, be made at intervals of twenty or thirty yards. Where the miners can commence the work of ascent before the cars, and get out ahead of them, there is not so much danger, but where the train moves first, and the men follow after, and have to get out of the way of the passage of the empty trains returning, as at the Church Hill Coal Company's slope, the danger is ever present. No miner ever attempts the ascent of this slope without experiencing some degree of fear.

There appears to be a misunderstanding of the requirements of the law in the case of two outlets, the miners contending that in order to conform to the letter and spirit of the act, both outlets must be provided at all times with available means of egress, otherwise safety is not assured, while the operators claim that the two openings are sufficient if the second one can be made available for the withdrawal of the men before they would perish, in a case of the closing of the main-opening by fire or otherwise. As this part of the act is not yet in force, I have given no opinion on the question.

No Inspector, single-handed, can do the work required by the law, and I would recommend that provision be made for the appointment of an assistant, and that such assistant be a practical miner, thoroughly conversant with the various systems of mining and ventilation in practice. Or it might serve every purpose to authorize the Inspector to appoint a practical miner, of known ability and good judgment, to examine certain mines in any region where he had reason to believe the law was being violated, so that the Inspector could promptly give his time and attention to places needing his presence.

Much of the Inspector's time is needed in the office, extending maps, answering correspondence, etc. This work might be equally well done with a clerk in the office, but this would require the clerk to have a knowledge of mine surveying and the drawing of mine plans or maps. In my judgment, an assistant, in the person of a competent, practical miner, to assist in inspecting the mines, would best serve the end in view.

Unless periodical visits are made to the mines, to see that the law is properly complied with, it will not be enforced as it should be. This was well illustrated in the law of 1870, which, although containing severe pains and penalties for any infraction of its provisions, was openly disregarded at nearly every coal mine in the State, because there were no proper officers to enforce its provisions and apply its precepts.

With one assistant, in the person of a competent, practical miner, giving his whole time and attention to the examination and inspection of the mines, and with the chief Inspector doing the same thing as often as his other duties will permit, the work required by the law can be efficiently done. As the mines are made more safe and healthy, in accordance with the requirements of the law, they will need less frequent inspection, though under all circumstances and conditions they should be visited and examined at least twice a year.

Respectfully submitted,

ANDREW ROY,
State Inspector of Mines.

SUPPLEMENT.

Columbus, *January* 30, 1875.

The following circular was sent to all the coal companies in the State, as far as known:

Office of State Inspector of Mines,
Columbus, Ohio, *December* 31, 1874.

Gentlemen:—I shall be greatly obliged if you will furnish me on receipt, for publication in my forthcoming annual report, a statement of the amount of coal mined, the number of men employed, etc., at your mines, for the year ending December 31, 1874.

The facts furnished will be treated as strictly confidential, if you desire it, and will not be published, except in the aggregate production of the State.

Name of mine; county where located; name of coal company, or firm, or proprietors; post-office address; description of mine—shaft, slope, or drift; depth of mine below the surface (in feet); average number of inside men and boys, including roadmen, drivers, etc.; average number of outside men and boys, including engineer, weighmaster, etc. Annual production for the past three years Tons, of 2000 pounds, in 1872; tons, of 2000 pounds, in 1873; tons, of 2000 pounds, in 1874.

Very respectfully,
ANDREW ROY,
State Inspector of Mines.

Answers were not as generally returned as I expected; but I am able to make at least an approximate estimate of the facts sought to be obtained. The following will be found to be nearly correct, using round numbers. The estimate is for the last three years:

Approximate Estimate.

	1872—Tons.	1873—Tons.	1874—Tons.
Mahoning valley	1,334,000	1,330,000	1,250,000
Tuscarawas valley	1,000,000	900,000	950,000
Hocking valley, including Straitsville and Shawnee	900,000	1,225,000	700,000
Pomeroy region	400,000	350,000	100,000
Salineville, including Irondale, Hammondsville, etc	400,000	325,000	150,000
Bellair region	200,000	200,000	100,000
Jackson region	100,000	125,000	75,000
Coshocton region	120,000	75,000	70,000
Ironton region	100,000	100,000	75,000
Leetonia and New Lisbon	150,000	100,000	125,000
Other regions	400,000	450,000	225,000
	5,104,000	5,080,000	3,820,000

It is very difficult to arrive at even an approximate estimate of the number of miners in the State, as last year there was so much wandering from place to place, caused by the mines shutting down. The following is as near an estimate as can be made, under the circumstances, for 1874:

Mahoning valley	3,500
Tuscarawas valley	3,000
Hocking valley	2,500
Pomeroy region	800
Salineville region	800
Bellair region	500
Steubenville region	500
Jackson region	300
Coshocton region	300
Ironton region	200
Leetonia region	200
Other districts	500
	12,500

The above estimate is based upon the number of miners working last year, which in good times would be at least one-half more, making the underground force of the State fully 18,500 souls. To this list there must be added the outside men employed in removing the coal to the railroad shutes, etc., which, on an average, is one to every ten miners, making 1,850, and a total of 20,350 hands employed in and about the mines of the State during full work.

Taking the number of fatal accidents at 27, and adding 3 which were not reported, and the output at 3,820,000 tons, we would have one death for every 127,333 tons mined; and estimating the number of miners employed at 13,300, we would have one death for every 333 men employed, which is greatly in excess of England, though less than Pennsylvania. If we wish to reduce this death-list to its minimum, we must have better undergound discipline, and forbid new hands from assuming the risks and responsibilities of miners until they understand the perils of the mine.

STATEMENT OF COAL MINED IN THE UNITED STATES IN THE YEAR 1873.

[From Saward's Coal Trade Journal.]

	Tons.
Pennsylvania (official)	34,523,560
Maryland, "	2,674,100
Virginia (estimate)	60,000
West Virginia (estimate)	1,000,000

		Tons.
Ohio (Secretary of State's Report*)		3,944,340
Kentucky (estimate)		400,000
Tennessee,	"	400,000
Alabama,	"	60,000
Michigan,	"	50,000
Indiana,	"	1,500,000
Illinois,	"	3,500,000
Iowa,	"	350,000
Missouri,	"	1,000,000
Kansas,	"	50,000
		49,512,000
Colorado, Wyoming, Utah, and Pacific Coast (lignites, estimate)		1,000,000
Total amount		50,512,000

CHARACTER OF COAL.	Tons.
Anthracite coal	22,828,178
Semi-bituminous coal	5,272,803
Bituminous coal	21,411,019
Lignite coal	1,000,000
Total	50,512,000

BRITISH INSPECTORS' REPORTS.

The reports of the inspectors of mines for the year 1873 form a bulky volume of about four hundred pages, and contain much interesting information, many useful suggestions, and an immense collection of statistics. They are prefaced by a series of tabulated summaries, which show (1) the number of persons employed on the surface and below ground in each of the districts under inspection; (2) the products of the mines of each district; (3) the number of fatal accidents, and the lives lost thereby; and (4) the proportion which the loss of life bears, first, to the total number of persons employed, and, secondly, to the quantity of minerals raised.

From the first of these summaries it appears that in the aggregate 512,199 persons were employed in and about the coal, fire-clay, ironstone, and oil-shale mines of Great Britain, and 1,950 in Ireland, being a total of 514,149 persons in Great Britain and Ireland, exclusive of those employed at the other mines, which are classed under the Metaliferous Mines Regulation Act. The numbers and ages of the persons employed under ground are distinguished from those employed above ground in nine out of the twelve districts, and in the other three districts the persons under ground are separated approximately from those above ground. The total number of persons employed thus separated shows that in Great Britain 406,599 were under ground, and 105,600 above ground, and in Ireland 1,209 under ground, and 741 above ground.

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* This report is too low, but, it will be observed, places Ohio second on the list of coal-producing States notwithstanding.

From the second summary it appears that in the aggregate 128,544,400 tons of coal, 1,738,491 tons of fire-clay, 12,094,827 tons of ironstone, and 524,095 tons of oil-shale were produced from the mines in Great Britain; and 135,731 tons of coal, and 3,702 tons of fire-clay from the mines in Ireland.

The summary of fatal accidents and lives lost in and about the mines shows that at the mines classed under the Coal Mines Regulation Act in Great Britain (the Coal Mines Act not being in operation in Ireland until 1874), the fatal accidents amounted to 973, and the deaths (some of the accidents causing more than one death) amounted to 1,069. Of these, 902 of the accidents and 994 of the deaths were at coal and fire-clay mines, nearly all being at coal mines. Amongst the fire-clay mines now comprised by the act, there are some where coal is not wrought, which were not previously comprised, but the number is small, and does not materially affect a comparison of the present accidents and deaths with those reported for previous years. As compared with those of the preceding year, the accidents in 1873 are an increase of eight, but the deaths are a decrease of sixty-six.

From the fourth summary (showing the proportion which the accidents and deaths bear to the persons employed and mineral wrought) it appears that on the average in 1873 in Great Britain there was at all the mines under the Coal Mines Act one fatal accident amongst every 526 persons employed in and about the mines, and one death by accident amongst every 479 persons; also, that 146,867 tons of mineral were got for each fatal accident, and 133,677 tons for each death by accident. In the preceding year the fatal accidents and deaths at the coal and comprised fire-clay mines were more numerous in proportion, being one accident and one death respectively amongst the lesser numbers of 468 and 394 persons employed, and for the lesser quantities of 138,024 and 116,409 tons of mineral wrought. The oil-shale mines are all newly comprised, and so are likewise the ironstone mines of Cleveland, etc., and numerous black-band ironstone mines, so that no comparison can be made with previous years as to these mines.

The following is a general summary of the uses for which the coal raised was employed:

	Tons.
Coal exported to foreign countries	12,712,222
" used on railways	3,790,000
" in iron manufacture	35,119,709
" in smelting other metals	763,607
" in mines and collieries	9,500,000
" in steam navigation	3,650,000
" in steam power in manufactories	27,550,000
" in gas manufacture	6,560,000
" in water-works	650,000
" in potteries, glass-works, brick, lime, and cement kilns	3,450,000
" in chemical works, and all other sundry manufactures	3,217,229
" domestic consumption	20,050,000
Total	127,012,767

PROPORTION OF ACCIDENTS AND LIVES LOST.

The following summary shows the proportion of accidents and lives lost to the number of persons employed in and about the coal, fire-clay, ironstone, and oil-shale mines, and the quantity of minerals wrought in Great Britain during the year 1873:

District.	Persons employed.		Tons mineral wrought.	
	Per fatal accident.	Per life lost.	Per fatal accident.	Per life lost.
Northumberland, Cumberland, and North Durham	513	496	149,752	145,023
South Durham and Westmoreland	711	702	238,684	235,543
Cleveland (ironstone)	389	374	226,468	217,409
North and East Lancashire	462	430	117,703	109,750
West Lancashire and North Wales	418	338	101,867	82,308
Yorkshire	543	496	148,068	135,304
Derby, Leicester, Nottingham, and Warwickshire	618	594	155,155	149,263
North Stafford, Cheshire, and Shropshire, (including ironstone)	546	397	165,311	120,226
South Stafford and Worcester	518	478	164,134	151,345
Monmouth, Gloucester, Somerset, and Devonshire	543	491	109,368	98,735
South Wales (including ironstone)	419	385	107,761	101,368
East Scotland (including ironstone and shale)	598	573	163,798	156,973
West Scotland (including ironstone and shale)	565	520	145,065	135,552
Total average	526	479	146,867	133,677

The following is a general summary of the returns of the mineral produce of the United Kingdom for 1873:

Minerals.	Quantities.		Value.
	Tons.	cwts.	
Coal	127,016,747	0	£47,631,280
Iron ore	15,577,499	0	7,573,676
Copper ore	80,188	10	342,708
Tin ore	14,884	17	1,056,835
Lead ore	73,500	10	1,131,907
Zinc ore	15,969	0	61,166
Iron pyrites	58,924	3	35,485
Arsenic	5,448	17	22,854
Bismuth	1	4	68
Cobalt	0	6	12
Manganese	8,671	6	57,766
Ochre and umber	6,368	8	5,410
Wolfram	49	19	526
Clay, fine and fire, and shale (estimated)	1,785,000	0	656,300
Salt	1,785,000	0	892,500
Barytes	10,269	11	7,993
Other earthy minerals (estimated)			3,000
Total value of the minerals produced in the United Kingdom in 1873			£59,479,486

PENNSYLVANIA INSPECTORS' REPORTS.

The reports of the Pennsylvania inspectors for the year 1873 show one fatal accident for every 83,457 tons mined, which is greatly in excess of Great Britain, and is also in excess of former years in Pennsylvania. In Great Britain 512,199 persons were employed in and about the coal mines in 1873. The amount of coal raised was 128,544,400 tons; the number of fatal accidents being 973, and the number of deaths 1,069. The number of hands employed in Pennsylvania in and around the anthracite coal mines in 1873 was 56,409; the number of persons killed was 264; and the amount of coal raised was 22,823,178 tons.

In Great Britain the mine operators are obliged by law to return the amount of coal mined, and to report at once to the inspector of the district the occurrence and cause of all accidents—fatal and serious alike. In Pennsylvania the coal product is annually published by Messrs. Bannan and Ramsey, of the Pottsville Miners' Journal, but in Ohio, for some cause many of the operators of the mines positively refuse to give report of the coal mined, and the reports of the assessors are bad guess-work, without any approximation of facts.

NAMES OF PERSONS KILLED, AND CAUSE OF DEATH, IN AND ABOUT THE MINES FOR THE YEAR 1874.

Date.	Names.	Names of Mines.	Cause of Death.
Jan. 5	Boy (name not given)	Silver Creek shaft	Fell down shaft.
26	Isaac Martin	Furnace Coal Company	Fall of slate.
Feb. 15	Baer Shelby	Cambridge Coal and Coke Company	Fall of rock.
23	James Davidson	Newark Coal Company	Fall of slate.
Mar. 19	William Howard	Washingtonville slope	Kicked by a mule.
April 18	Dallas Roberts	Stewart mine (Mahoning county)	Fall of roof.
July 17	Francis King	Hanging Rock	Drawing pillars.
Aug. 10	William Wolf	Haydenville mines	Fall of coal.
	Boy (name not given)	"	Run over by cars (outside).
Sept. 10	E. G. Pickering	Brooks' mines	Fall of coal.
16	Wm. Saterfield	"	Fall of slate.
11	Thomas Davis	Newark Coal Company	Struck by piece of iron (outside).
Oct. 12	George Longly	Brooks' mines	Fall of coal.
Sept. 25	John Fisher	Aberdare shaft	Struck by coal in shaft.
Nov. 1	—— ———	Silver Creek	Fall of slate (lived 10 days).
6	Joseph Vintus	Longstreth mines	Fall of coal.
9	William Wilson	Chippewa mines	Fall of slate.
16	Jacob Berg	Grove Coal mine	Fell down shaft.
20	Joseph Norman	Maple Grove	Bursting of boiler.
	James Moore	"	" "
24	Mrs. Huber	Aberdare	Run over by cars on tramroad (outside).
26	George Fudge	Ashland slope	Fall of roof.
June 20	Robert Cundiff	Syracuse slope	Explosion of powder blast.
Dec. 24	John Rice	Kyle shaft	" "
30	August Carraba	Church Hill slope	Fall of roof.
	Michael Walsh	Wadsworth mine	Fall of slate.
Aug. —	Frank Moore	Highland mine	"

NAMES OF PERSONS SERIOUSLY INJURED IN AND ABOUT MINES, AND CAUSE OF ACCIDENT, FOR THE YEAR 1874.

DATE.	NAME.	NAME OF MINE.	CAUSE OF ACCIDENT.	KIND OF INJURY.
Jan. 3	——— ———	Silver Creek	Fall of slate	Back broken.
15	Andrew Dagan	Niles shaft	Premature blast	Badly hurt on face and head.
27	G. Mackinshaw	Newark and Straitsv'le	Explosion of powder	Badly burned on face.
30	H. Williams	" "	Fall of slate	Not stated.
Feb. 15	Benj. Senior	Leetonia slope	Hurt with wedge	Lost one eye.
17	Wm. Hall	Cherry Run	Cars running away	Thigh broke and other injuries.
	Joseph Smith	"	Fall of coal	Injury not stated.
Mar. 4	C. Constant	Church Hill slope	Fall of slate	Thigh broke and otherwise injured.
14	Ed. Goodge	Powers' slope	Cars running off track	Leg broke.
	Thos. Davis	"	Kicked by mule	Injury not stated.
15	Frank Horvier	Fairview mine	Cage ran away in shaft	Badly hurt.
	C. Lensler	"	" "	"
25	John Missop	Maple Grove	Fall of slate	Injury not stated.
	Jas Sutherland	"	Riding on loaded car	" "
Apr. 3	A. Shearer	Fairview mine	Fall of slate	Leg broke.
7	Andrew Tarr	La Grange shaft	Rock falling in shaft	Injury not stated.
10	Jas. Kay	Niles Coal Company	Cars running off track	Thigh broke.
	Wm. Morgan	Ward, Warner & Co	Fell down shaft	Fell 100 ft.(soon recovered).
27	J. Rolland	Tod & Wells' shaft	Fall of coal	Injury not stated.
May 6	R. Morris	Arnes & Wick	Cars running away on slope	" "
21	Ben. Smith	Powers' slope	" "	" "
5	Geo. Arnold	Shawnee mines	Fall of coal	Cut on head.
30	J. W. Williams	Church Hill slope	Cars running away on slope	Badly crushed in limbs.
June 1	Th. Brooks	Church Hill shaft	Fall of slate	Bruised in leg.
	J. Plethory	Kyle shaft	Premature explosion	Both eyes blown out and otherwise badly injured.
2	J. W. Miles	Thorn Hill	Fall of roof	Badly bruised.
	Thos. Miles	"	"	Leg broke in two places.
24	Geo. Keeley	N. and O. Coal Co	Run over by cars	Leg broke; hurt otherwise.
26	Henry Lotz	Burnett slope	Fall of coal	Leg taken off; otherwise hurt.
	Enoch Bailey	Cambridge mines	"	Leg broke; otherwise hurt.
10	J. McKinzie	Crawford slope	Fall of roof	" "
17	Jacob Sherber	Rhodes shaft	Fall of slate	" "
July 15	Thos. Savage	Church Hill slope	"	Bruised in body.
	R. Lewis	Niles shaft	"	Injury not stated.
21	Joseph Holtz	Hanging Rock	"	Leg broke.
25	M. Sneider	McKinnie slope	"	Back broken.
Aug. 5	Reese Lewis	Church Hill slope	"	Leg broken.
10	R. Barkley	Niles Coal Company	Run over by cars outside	Shoulder blade broke.
18	——— Cook	Kyle shaft	Explosion of fire-damp	
27	W. Cartright	Straitsville Central	Run over by cars	Badly hurt.
Sept. 5	General James	Longstreth mine	"	
	John Wallace	Straitsville Central	Hand mashed between cars	
17	Robt. Roberts	Crawford slope	Cars running away on slope	Thigh broke and otherwise hurt.
25	——— ———	Floodwood	Fall of slate	
	Geo. Besely	Aberdare shaft	Coal fell down shaft	
	David George	Crawford slope	Fall of coal	Collar bone broke.
	M. Harrison	Longstreth's mine	Riding on cars	Leg broke.
Oct. 8	W. Elliot	Lick Run	Premature blast	Badly burned; arm broke.
	——— ———	Globe shaft	"	
	——— ———	"	"	
5	Evan Thomas	Haroff slope	Hanging shot	Badly bruised.
12	Sam'l Es ale		Fall of slate	
16	A. Barclay	Longstreth mines		Leg broke.
12	Hugh Wayers	Carbondale	Fall of coal	Collar and cheek-bone broken.
	David Jones	Chippewa	"	Injury not stated.
25	Reese Lewis	Church Hill slope	"	Leg broke (second injury this year).
Nov. 4	Robt. Roberts	Niles Coal Company	Run over by cars outside	
6	Frank Campbell	Longstreth mine	Fall of coal	Collar and cheek-bone broken.
July 16	Jas. Mallory	Cramer mines	"	Leg broken.
June 15	G. W. Neuse	Syracuse shaft	"	Hip knocked out of joint.
Sept. 24	Barney Curtis	Excelsior mine	"	
Nov. 15	Bryan O'Connor	Brown's mines	Fall of roof	Badly hurt.
Dec. 10	Wm. Morgan	Dabney mine	Crush'd betw'n rail and cars	Bruised badly.
27	T. Smith	Central mine	Kicked by horse	Burned badly; arm broke.
Aug. 20	Joseph Thomas	Church Hill slope	Fall of slate	Bruised.
Sept. 1	John D. Williams	" "	Caught between cars	Hand smashed.
Sept. 15	P. Parynes	Troy mine	Fall of coal	Leg broke; badly crushed.
1	J. Miller	"	"	Badly crushed.
Nov. 18	John Edwards	"	Run over by cars	Leg broke and otherwise bruised.
Dec. 18	A. Barksdale	"	"	Leg broke; badly bruised.
Aug. —	W. Shelhammer	Straitsville Mining Co.	Caught between car and rib	Hand mashed.
	Thos. McCune	Cin. Coal and Coke Co.	Fall of slate	
	John Loferty	" "	Fall of coal	Collar bone fractured.
Apr. —	L. Knavle	Chippewa	"	Both legs broken.

Several accidents were reported in addition to the above, but no name nor date was sent.

LIST OF MINES, OPERATORS, ETC., IN THE STATE, SO FAR AS KNOWN.

TRUMBULL COUNTY.

Name of mine.	Names of operators.	Post-office address.	Description of mine.	Average number of men and boys inside.	Average number of hands outside.
Hood mine	Arms & Wick	Youngstown, Ohio	Slope	53	7
Sodom slope	McCurdy Coal Company	" "	"	85	13
Church Hill slope	Church Hill "	" "	"	185	23
Church Hill shaft	Niles "	" "	Shaft	198	27
Kline slope	Briar Hill Iron Company	" "	Slope	80	8
Moore Coal Company	Moore Coal Coal "	" "	"	Idle.	
Halliday bank	C. H. Andrews & Co.	" "	"	90	.10
Tyler bank	C. H. Andrews & Bro.	" "	"	82	8
Wheeler slope	Vienna Coal and Iron Company.	" "	"	75	7
Vienna shaft	" " "	" "	Shaft	64	6
Shenango slope	Shenango Coal Company	Wheatland, Pa.	Slope	113	13
Brookfield slope	Brookfield "	Sharon, Pa.	"	190	15
Burnett slope	Burnett "	Youngstown, Ohio	"	120	10
Jacobs shaft	Jacobs & Son	" "	Shaft	100	6
Carbon valley	Wick, Struthers & Co.	" "	"	10	
Stewart slope	Mahoning Coal Company	" "	"	132	9
Mahoning No. 3	" "	" "	"	150	10
Long bank	" "	" "	"	80	7
Brookfield shaft	Payne, Newton & Co	Cleveland, "	Shaft	110	15
Ashland slope	Ward, Warner & Co.	Mineral Ridge, "	Slope	60	7
Weathersfield shaft	Wise Coal Company	" " "	Shaft	200	11
Curtis Hill	Curtis & Boyce	Sharon, Pa.	Drift	155	12

MAHONING COUNTY.

Name of mine.	Names of operators.	Post-office address.	Description of mine.	Average number of men and boys inside.	Average number of hands outside.
McKinnie	J. B. Warner & Co	Mineral Rdge, Ohio	Shaft	65	8
Wick and Wells shaft	Wicks & Wells	Youngstown, "	"	70	8
McKinnie slope	Mahoning Coal Company	" "	Slope	90	7
Foster shaft	Foster "	" "	Shaft	65	4
Kyle shaft	Kyle "	" "	"	74	5
Tod and Wells shaft	Josiah Robbins & Co	Mineral Ridge, "	"	110	·8
Ward, Warner & Co.	Ward, Warner & Co.	" "	"	75	7
Oldtown shaft	Harris, Maurer & Co	" "	"	70	7
Foulk slope	Foulk Coal Company	" "	Slope	Idle.	
Pennell slope	New Lisbon Coal Company	New Lisbon, "	"		
Huroff slope	Huroff "	Youngstown, "	"	90	7
Thorn Hill	Powers, Arms & Co	" "	"	36	6
Packard slope	Packard Coal Company	" "	"	36	6
Powers slope	Powers "	" "	"	130	8
Holland coal mines	Charles, Moore & Co.	" "	"	7	3
Cleveland shaft	Caleb Wick	" "	Shaft	40	6
Austin mines	John Morris & Co.	Mineral Ridge, "	"	100	11

ATHENS COUNTY.

Name of mine.	Names of operators.	Post-office address.	Description of mine.	Average number of men and boys inside.	Average number of hands outside.
Section 29	W. B. Brooks & Son	Nelsonville, Ohio	Drift	123	12
Longstreth mine	T. Longstreth	" "	"	141	13
L. D. Poston & Son	L. D. Poston & Son	" "	"	27	4
Poston's	L. D. Poston	" "	"	26	4
New York	New York and Ohio Coal Co	" "	"	50	7
Co-operative mine	Nelsonville Mining Company	" "	"	56	5
Lick Run	Lick Run Coal Company	Lick Run, "	"	87	9
Ladrel Hill	Laurel Hill "	" "	"	19	3
Sheffield's	B. B. Sheffield	Floodwood, "	"	48	7
Hamley's Run	Columbus and Hocking Coal Co	Athens, "	Shaft	27	3
Star	Star Mining Company	Nelsonville, "	Drift	14	2
Harper's	Harper Brothers	" "	"	30	4
Big Run	Federal Creek Coal Company	Big Run "	Shaft	43	7
—— ——	King Brothers	King's Switch, "			
Carbondale	Carbondale Coal Company	Mineral City, "	Drift	110	10
—— ——	Buckeye "				
Salina shaft	G. F. Gould	Salina, Ohio	Shaft	8	2
Chancey shaft		Chancey, "	"	6	2

PERRY COUNTY.

Name of mine.	Name of operators.	Post-office address.	Description of mine.	Average number of men and boys inside.	Average number of hands outside.
Central	Straitsville Central Mining Co	New Straitsville, Ohio	Drift	45	4
Straitsville Mining Co.	Straitsville Mining Company	" "	"	90	10
Troy	Straitsville Mining and Coal Co	" "	"	110	10
Mungen's	Great Vein Coal and Iron Co	" "	"	......	......
Stewart's mine	Lancaster and Straits Coal Co	" "	"	35	5
Plummer Hill	Straitsville Coal Company	" "	"	100	12
XX mines	Newark "	Shawnee, "	"	175	12
New York mine	New York and Straitsville Coal and Iron Company	" "	"	109	13
Lonsdale	Straitsville Cannel Coal Company of New York	" "	"	50	12
Furnace bank	Furnace Coal Company	" "	"	37	4
Upton's bank	Card and Upton Coal Company	" "	"	14	3
Shawnee Valley	Shawnee Valley Coal and Iron Co.	" "	"	40	4

HOCKING COUNTY.

Name of mine.	Name of operators.	Post-office address.	Description of mine.	Average number of men and boys inside.	Average number of hands outside.
Gore mines	Straitsville and Monday Creek Coal Mining Company	Gore, Ohio	Drift	50	8
Section 19	W. B. Brooks & Son	Nelsonville, "	"	147	10
Hayden's mines	Peter Hayden	Haydenville, "	"	170	30

MEIGS COUNTY.

Name of mine.	Name of operators.	Post-office address.	Description of mine.	Average number of men and boys inside.	Average number of hands outside.
Pamunkey	Pomeroy Coal Company	Pomeroy, Ohio	Drift	......	......
Minersville	"	" "	"	......	......
Excelsior	"	" "	"	450	22
Peacock	"	" "	"		
Dabney	"	" "	"		
Diamond	"	" "	"	......	......
Williams' bank	Ebenezer Williams	Minersville, "	"	90	16
Coal Ridge	Coal Ridge Salt Company	Pomeroy, "	"	21	2
Buckeye	Buckeye Salt Company	" "	"	14	3
Syracuse slope	M. Nye & Son	Syracuse, "	Slope	90	5
Syracuse shaft	Syracuse Coal and Salt Compyny	" "	Shaft	124	12
Antiquity	Ohio Coal Company	Racine, "	"	30	6
Middleport	Middleport Salt Company	Middleport, "	Drift	10	2
Pomeroy mine	S. M. Pomeroy	Pomeroy, "	"	7	1
—— ——	Leadington Coal Company	......	"	......	......
—— ——	Cheshire Coal Works Company	......	"	......	......

JEFFERSON COUNTY.

Name of mine.	Name of operators.	Post-office address.	Description of mine.	Average number of men and boys inside.	Average number of hands outside.
Market Street shaft	Steubenville Iron Company	Steubenville Ohio	Shaft	......	......
Stony Hollow	" "	" "	"	......	......
—— ——	Ohio and Pennsylvania Coal Co.	" "	"	62	21
—— ——	Cincinnati Coal and Coke Co	" "	"	80	22
Mingo shaft	Mingo Iron Works Company	Mingo, "	"	4	1
—— ——	Steubenville Furnace and Iron Company	Steubenville, "	"	20	5
Rush Run shaft	Peck & Ramsey	Rush Run, "	"	10	7
La Grange shaft	La Grange Coal Company	La Grange, "	"	......	......
Rolling-Mill shaft	Spaulding, Woodward & Co	Steubenville, "	"	85	10
—— ——	Morgan Iron and Coal Company	Irondale, "	Drift	Idle.	......
—— ——	" "	" "	"	Idle.	......
—— ——	" "	" "	"	Idle.	......
—— ——	Hammondsville Coal and Coke Co.	Hammondsville, Ohio	"	Idle.	......
—— ——	" "	" "	"	Idle.	......
Strip Vein	W. H. Wallace & Son	" "	Shaft	52	9
Diamond	"	" "	Drift	16	4

LAWRENCE COUNTY.

Name of mine.	Name of operators.	Post-office address.	Description of mine.	Average number of men and boys inside.	Average number of hands outside.
Hanging Rock	Means, Kyle & Co	Hanging Rock, Ohio	Drift	......	......
—— ——	Ironton Iron Works Company	Ironton, "	"	......	......
—— ——	Etna Iron Company	" "	"	......	......
Lawrence Run	Lawrence Iron Works Company.	Lawrence, "	"	40	2
Sheridan Coal Works	Sheridan Mining Company	Sheridan, "	"	80	12

JACKSON COUNTY.

Name of mine.	Name of operators.	Post-office address.	Description of mine.	Average number of men and boys inside.	Average number of hands outside.
Milton	Milton Furnace and Coal Co.		Shaft	25	4
Welston	Wilston Coal and Iron Company	Wilston, Ohio	"	14	2
Star mines	Star Furnace Company	Jackson, "	"	30	3
Tropic	Tropic " "	" "	"	24	3
Orange mines	Orange Iron "	" "	"	25	2
Globe mines	Globe " "	" "	"	33	2
Huron	Huron " "	" "	"	27	3
Erie	Erie " "	" "	"	14	2
Price's	Price Brothers	" "	Drift	8	2
Petrea mines	Petrea Coal Company	" "	"	68	10
Kitrick's	Thos. M. Kitrick	" "	"	10	2
GUERNSEY COUNTY.					
Scott's mines	Scioto Coal and Salt Works	Cambridge, Ohio	Drift	44	6
Cambridge mines	Cambridge Coal Mining Co.	" "	"	75	7
Central shaft	Cent'l Shaft Salt, Coal & Coke Co.	Danford, "	"	35	7
Ohio mines	Ohio Coal Company	Marietta, "	"	50	6
—— ——	Ohio and Marietta Coal Co.	" "	"	26	7
CARROLL COUNTY.					
Brown's mines, big vein	Matthew Brown	Salineville, "	Drift	Idle.	
Brown's mines, strip "	"	" "	"	40	5
Robertsville mines	Cleveland Iron Company	" "	"	Idle.	
Robertsville mines	" "	" "	"	Idle.	
—— ——	Dutchen & Davis	" or Clevel'd	"	Idle.	
MUSKINGUM COUNTY.					
—— ——	Henry Jones	McLung Station, O.	Drift	22	4
Del Carbo	Diamond Mining Co.	Roseville, Ohio	"	18	3
There are a number of other mines in this county, but the region has not been visited yet.					
STARK COUNTY.					
Foultz's slope	Fulton Coal Company	Canal Fulton, Ohio	Slope	68	9
—— ——	Buckeye Coal "	" "	"		
—— ——	Fulton Mining "	" "	"	60	13
Crawford shaft	Crawford Coal "	Massillon, "	Shaft	180	20
Crawford slope	" "	" "	Slope	83	15
Burton's	J. P. Burton	" "	Shaft	13	5
Willow slope	Willow Bank Coal Company	" "	Slope	225	21
Willow shaft	" "	" "	Shaft		
Williamson's shaft	A. B. Williamson	" "	"	23	5
Maple Grove	Massillon Coal and Mining Co.	North Lawrence, O.	Slope	190	16
Aberdare shaft	Youngstown Coal Company	Massillon, Ohio	Shaft	126	14
Jacobs shaft	Rhodes "	" "	"	184	8
—— ——	Massillon "	" "	"	80	8
Grove mine	Grove "	" "	"	59	11
SUMMIT COUNTY.					
Summit mine	Summit Mine Coal Company	Akron, "	Drift	195	15
Brewster's slope	Brewster "	" "	Slope	65	7
Brewster's bank	" "	" "	Drift	65	7
Brewster Bros. bank	Brewster Brothers	" "	Slope	43	3
Middlebuyy shaft	Middlebury Coal Company	" "	Shaft	100	7
Johnson shaft	Johnson "	" "	"	130	8
Dennison bank	Dennison "	Sherman, "	Drift	Idle.	
Barges	Barges & Sons	Akron. "	"		
—— ——	Norton Coal Company	Sherman, "	"		
WAYNE COUNTY.					
Fairview bank	J. P. Burton & Co.	Massillon, "	Shaft	55	9
Crawford's	Crawford, Scott & Co.	" "	Slope	28	4
Silver Creek No. 1	Silver Creek Coal Company	Doylestown, Ohio	Shaft	160	15
Silver Creek No 2	" "		Drift		
—— ——	Franklin "	Akron, "			

BELMONT COUNTY.

Name of mine.	Name of operators.	Post-office address.	Description of mine.	Average number of men and boys inside.	Average number of hands outside.
Belmont Works No. 1	Heatherington Brothers	Bellair, Ohio		28	3
Belmont Works No. 2	“ “	“		24	3
Pittsburgh Works	Rockinghouser & Sterritt	“		23	12
Weegee	B. Shaver & Co	Weegee, Ohio	Slope	25	5
Empire	Empire Works	“		Idle.	
Union mine	Union Coal Company	Moundsville, W. Va		38	4
—— ——	Purdy & Lashley	“ “		36	4
—— ——	E. G Morgan	Bellair, Ohio	Drift	10	4
Barnard's Coal Works	W. G. Bernard	“	“	24	8
Franklin	Sterritt & McMahon	Franklin, Ohio		14	2
Pipe Creek	Pipe Creek Coal and Iron Co	Dilley's Bottom, Ohio	Slope	22	10
COLUMBIANA COUNTY.					
State Line	State Line Coal Company	East Palestine, Ohio	Drift	78	8
Prospect mine	Prospect Coal Company	“ “	“	161	21
Robins' mine	New Lisbon Coal Company	New Lisbon, Ohio	“	31	12
Cherry Valley	Cherry Valley Iron Company	Leetonia, Ohio	“ (2)	67	6
Grafton	Grafton Coal and Iron Company	“	Shaft	81	11
Washingtonville mines	Cherry Valley Iron Company	“	Slope	53	17
Salem shaft	Salem Coal and Iron Company	Salem, Ohio	Shaft	Idle.	
—— ——	Manufacturing Coal Company	Salineville, Ohio	Drift	25	8
Farmers' mine	James Farmer	“ “	“	25	8
Foster's banks	Harding & Hall	“ “	“ (2)	50	3
Haysville bank	John Hays & Co	“ “	“	30	6
Rockville mine	McGary & Gallager	“ “	“	20	5
Empire mine	Empire Coal Company	“ “	“	40	10
Hays' mine	Ohio and Pennsylvania Coal Co	“ “	“	36	5
Jones' mine	“ “ “	“ “	“	59	7
Hartford	“ “ “	“ “	“	40	8
Hussey & Hollow	“ “ “	“ “	“	30	6
—— ——	Granage & Anderson	“ “	“ (2)	60	7
TUSCARAWAS COUNTY.					
Block Vein Colliery	Block Vein Colliery Company	Dennison, Ohio	Drift	18	3
Dennison Colliery	Dennison Colliery Company	“ “	“	20	3
Andreas mines	S. W. Andreas & Co	Urichsville, Ohio	“	44	3
Stillwater mines	Stillawter Coal Company	“ “	“	34	4
Sycamore mines	Sycamore Coal Company	“ “	“	26	3
MEDINA COUNTY.					
Wadsworth slope	Wadsworth Coal Comany	Akron, Ohio	Slope	120	17
Diamond mine	Humphrey & Coleman	“	“	60	7
HARRISON COUNTY.					
Philadelphia mines	Philadelphia Coal and Mining Co.	Station 15	Drift	24	3
COSHOCTON COUNTY.					
Blaen Nant	Edward Prosser	Coshocton, Ohio	Drift	16	3
Rock Run	Rock Run Coal Company	“ “	“		
Coalport	Coalport Coal Company	“ “	“		
Summit	Franklin and Coalport Coal Co	Franklin Stat'n, Ohio	“		
Coshocton	Coshocton Coal Company	Coshocton, Ohio	“		
Diamond	Diamond Coal Company	Franklin Stat'n, Ohio	“		
Canesville	Ressler & Co	Newark, Ohio	“		
Pen Twyen	Pen Twyen Coal Company	Coshocton, Ohio	“	44	4
Home	Home Coal Company	“ “	“	36	7
Union mine	Union Coal Company	“ “	“	14	3
VINTON COUNTY.					
Vinton	Bancroft & Radee	Vinton Station, Ohio	Drift	10	1
Coalmont	Zaleski Company	Zaleski, Ohio	“	85	15
Zaleski	“ “	“	“		
—— ——	Vinton Coal and Iron Company	Vinton, Ohio	Shaft		

THE MINING LAW OF OHIO.

AN ACT TO REGULATE MINES AND MINING, AND TO REPEAL AN ACT THEREIN NAMED.

SECTION 1. *Be it enacted by the General Assembly of the State of Ohio*, That there shall be appointed by the governor, with the advice and consent of the senate, one mine inspector, who shall hold his office for four years, subject, however, to be removed by the governor for neglect of duty or malfeasance in office. Said inspector shall have knowledge of chemistry, geology, and mineralogy, and a practical knowledge of the different systems of working and ventilating coal mines, and of the nature and properties of the noxious and poisonous gases of the mines, particularly fire-damp, and mining engineering; and said inspector, before entering upon the discharge of his duties, shall take an oath or affirmation to discharge the same faithfully and impartially, which oath or affirmation shall be indorsed upon his commission; and his commission, so indorsed, shall be forthwith recorded in the office of the secretary of state, and such inspector shall give bond in the sum of five thousand dollars, with sureties to the approval of the governor, conditioned for the faithful discharge of his duty.

SEC. 2. Said inspector shall give his whole time and attention to the duties of his office, and shall examine all the mines in this state as often as his other duties will permit, to see that the provisions of this act are obeyed; and it shall be lawful for such inspector to enter, inspect, and examine any mine in this state, and the works and machinery belonging thereto, at all reasonable times, by night or by day, but so as not to unnecessarily obstruct or impede the working of the mine; and to make inquiry into the state and condition of the mine as to ventilation and general security, as required by the provisions of this act; and the owners and agent of such mine are hereby required to furnish the means necessary for such entry and inspection. of which inspection the inspector shall make a record, noting the time and all the material circumstances; and it shall be the duty of the person having charge of any mine, whenever loss of life shall occur by accident connected with the working of such mine, or by explosion, to give notice forthwith by mail, or otherwise, to the inspector of mines and to the coroner of the county in which such mine is situated, and the coroner shall hold an inquest upon the body of the person or persons whose death has been caused, and inquire carefully into the cause thereof, and shall return a copy of the verdict and all the testimony to such inspector. No person having a personal interest in, or employed in the management of, the mine where a fatal accident occurs, shall be qualified to serve on the jury impaneled on the inquest.

SEC. 3. Such inspector, while in office, shall not act as an agent, or as a manager, or mining engineer, or be interested in operating any mine; and he shall, annually, on or before the first day of January, make report to the governor of his proceedings, and the condition and operation of the mines in this state, enumerating all accidents in or about the same, and giving all such other information as he may think useful and proper, and making such suggestions as he may deem important as to further legislation on the subject of mining.

SEC. 4. Said inspector shall receive a salary of two thousand dollars per annum, and his necessary traveling expenses, to be paid in quarterly installments; and he shall have and keep an office in the state house, at Columbus, in which shall be carefully kept the maps and plans of all mines in this state, and also all records and correspondence, papers, and apparatus, and property pertaining to his duties, belonging to the state, and which shall be handed over to his successor in office.

SEC. 5. Any vacancy occurring when the senate is not in session, either by death or resignation, removal by the governor, or otherwise, shall be filled by appointment by the governor, which appointment shall be good until the close of the next session of the senate, unless the vacancy is sooner filled, as in the first section provided.

SEC. 6. There shall be provided for said inspector all instruments and chemical tests necessary for the discharge of his duties under this act, which shall be paid for on the certificate of the inspector, and which shall belong to the state.

SEC. 7. The owner or agent of every coal mine shall make, or cause to be made, an accurate map or plan of the working of such mine, on a scale of not less than one hundred feet to the inch, showing the area mined or excavated, and the location and connection with such excavation of the mine of the lines of all adjoining lands, and the name or names of each owner or owners, so far as known, marked on each tract, a true copy of which map the said owner or agent shall deposit with the inspector within six months after the passage of this act, and another copy of which shall be kept at the office of such mine; and the owner or agent shall, on or before the first day of September, 1874, and every four months thereafter, file with said inspector a statement and plan of the progress of the workings of such mine up to said date, which statement and plan shall be so prepared as to enable the inspector to mark the same on the original map or plan herein required to be made. In case of refusal on the part of said owner or agent, for two months after the time designated, to make and file the map or plan, or the addition thereto, the inspector is authorized to cause an accurate map or plan of the whole of said mine to be made at the expense of the owner thereof, the cost of which shall be recoverable against the owner in the name of the person or persons making said map or plan, which shall be made in duplicate, one copy being delivered to the inspector, and the other left in the office of the mine; and he shall, on being paid the proper cost thereof, on demand of any person interested in the working of such mine, or owner of adjoining lands, furnish an accurate copy of any map or plan of the workings of such mines.

SEC. 8. Twelve months from and after the passage of this act, it shall not be lawful for the owner or agent of any coal mine worked by a shaft, wherein over fifteen thousand square yards have been excavated, to employ any person to work therein, or to permit any person to work in such mine, unless there are to every seam of coal worked in each mine at least two separate outlets, separated by natural strata of not less than one hundred feet in breadth, by which shafts or outlets distinct means of ingress and egress are always available to the persons employed in the mine; but it shall not be necessary for the two outlets to belong to the same mine; and every shaft opened after the passage of this act shall have two such separate outlets, after fifteen thousand square yards have been excavated; and to all other coal mines, whether slopes or drifts, two such openings or outlets shall be provided within twelve months after the passage of this act, provided fifteen thousand square yards have been excavated at or before the passage of this act, or if not, then within twelve months after that extent has been excavated. In case such outlets are not provided as herein stipulated, it shall not be lawful for the agent or owner of any such mine to permit more than ten persons to work therein at any one time. In case any coal mine has but one shaft, slope, or drift for the ingress or egress of the men working therein, and the owner thereof does not own suitable surface ground for another opening, the owner may select and appropriate any adjoining land for that purpose, and for approach thereto, and said owner shall be governed in his proceeding in appropriating such land by the provisions of law in force providing for the appropriation of private property by corporations, and such appropriation may be made whether the owner of such mine is a corporator or not: Provided, that no land shall be appropriated under the provisions of this act until the court is satisfied that suitable premises cannot be obtained by contract upon reasonable terms.

SEC. 9. The owner or agent of every coal mine, whether shaft, slope, or drift, shall provide and maintain, within six months after the passage of this act, for every such mine, an amount of ventilation of not less than one hundred cubic feet per minute per person employed in such mine, and as much more as the inspector may direct, which shall be circulated to the face of each and every working place throughout the mine; and all mines generating fire-damp shall be kept free of standing gas, and in all mines where fire-damp is generated, every working place shall be carefully examined every morning, with a safety-lamp, by a competent person, before any of the workmen are allowed to enter.

SEC. 10. The owner or agent of every coal mine operated by shaft or slope, in all cases where the human voice cannot be distinctly heard, shall forthwith provide and maintain a metal tube from the top to the bottom of such shaft or slope, suitably calculated for the free passage of sound therein, so that conversations may be held between persons at the bottom and top of the shaft or slope; and there shall also be provided an approved safety-catch, and a sufficient cover over head, on all carriages used for lowering and hoisting persons, and in the top of every shaft an approved safety-gate, and also an approved safety-spring on the top of every slope, and an adequate brake shall be attached to every drum or machine used for lowering or raising persons in all shafts or slopes.

SEC. 11. No owner or agent of any coal mine operated by a shaft or slope shall place in charge of any engine used for lowering into or hoisting out of such mine persons employed therein any but experienced, competent, and sober engineers; and no engineer in charge of such engine shall allow any person, except such as may be deputed for that purpose by the owner or agent, to interfere with it, or any part of the machinery, and no person shall interfere, or in any way intimidate the engineer in the discharge of his duties; and in no case shall more than ten men ride on any cage or car at one time, and no person shall ride upon a loaded cage or car in any shaft or slope.

SEC. 12. All the safety-lamps used for examining coal mines, or which may be used in working any mine, shall be the property of the owner of the mine, and shall be under the charge of the agent of such mine; and in all mines generating explosive gas, the doors used in assisting or directing the ventilation of the mine shall be so hung and adjusted that they will shut of their own accord, and cannot stand open; and in all such mines the mining boss shall keep a careful watch over the ventilating apparatus and the air-ways, and he shall measure the ventilation at least once a week at the inlet and outlet, and also at or near the face of all the entries; and all such measurements shall be reported once a month to the inspector.

SEC. 13. No boy under twelve years of age shall be allowed to work in any mine, nor any miner between the ages of twelve and sixteen years, unless he can read and write; and in all cases of minors applying for work it shall be the duty of the agent of such mine to see that the provisions of this section are not violated.

SEC. 14. In case any coal mine does not, in its appliances for the safety of the persons working therein, conform to the provisions of this act, or the owner or agent disregards the requirements of this act, any court of competent jurisdiction may, on application of the inspector, by civil action, in the name of the state, enjoin or restrain the said owner or agent from working or operating such mine with more than ten miners at once, until it is made to conform to the provisions of this act; and such remedy shall be cumulative, and shall not take the place of or affect any other proceedings against such owner or agent authorized by law for the matter complained of in such action.

SEC. 15. Any miner, workman or other person who shall knowingly injure or interfere with any safety-lamp, air-course or brattice, or obstruct or throw open doors, or disturb any part of the machinery, or disobey any order given in carrying out the provisions of this act, or ride upon a loaded car or wagon in a shaft or slope, or do any act whereby the lives or health of the persons or the security of the mines and machinery is endangered, or if any miner or person employed in any mine governed by the provisions of this act shall neglect or refuse to securely prop or support the roof and entries under his control, or neglect or refuse to obey any order given by the superintendent in relation to the security of the mine in the part of the mine under his charge or control, every such person shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine not exceeding fifty dollars, or imprisonment in the county jail not exceeding thirty days, or both, at the discretion of the court.

SEC. 16. Whenever written charges of gross neglect of duty or malfeasance in office against any inspector shall be made and filed with the governor, signed by not less than fifteen coal miners, or one or more operators of mines, together with a bond in the sum of five hundred dollars, payable to the state, and signed by two or more responsible freeholders, and conditioned for the payment of all costs and expenses arising from the investigation of such charges, it shall be the duty of the governor to convene a board of examiners, to consist of two practical coal miners, one chemist, one mining engineer, and one operator, at such time and place as he may deem best, giving ten days' notice to the inspector against whom the charges may be made, and also to the person whose name appears first in the charges; and said board, when so convened, and having been first duly sworn or affirmed truly to try and decide the charges made, shall summon any witnesses desired by either party, and examine them on oath or affirmation, which may be administered by any member of the board, and depositions may be read on such examination as in other cases; and the board shall examine fully into the truth of such charges, and report the result of their investigation to the governor; and if their report shows that such inspector has grossly neglected his duties, or is incompetent, or has been guilty of malfeasance in office, it shall be the duty of the governor forthwith to remove such inspector and appoint a successor; and said board shall award the costs and expenses of such investigation against the inspector or the person signing said bond, according to their finding against said inspector or in his favor, which costs and expenses shall include the compensation of such board of five dollars per day for each member for the time occupied in the trial, and in traveling from and to their homes; and the attorney-general shall forthwith proceed to collect such costs and expenses, and pay the same into the state treasury, the said costs and expenses being in the first instance paid out of the state treasury on the certificate of the president of such board.

SEC. 17. In all coal mines in this state, the miners employed and working therein, the owners of the land, or other persons interested in the rental or royalty of any such mine, shall, at all proper times, have full right of access and examination of all scales, machinery or apparatus used in or about said mine to determine the quantity of coal mined, for the purpose of testing the accuracy and correction of all such scales, machinery or apparatus, and such miners, land-owners, or other persons, may designate or appoint a competent person to act for them, who shall, at all proper times, have full right of access or examination of such scales, machinery or apparatus, and seeing all weights and measures of coal mined, and the accounts kept of the same: Provided, not more than one person on behalf of the miners collectively, or one person on behalf of the land-owners or other persons interested in the rental or royalty jointly, shall have such right of access, examination and inspection of scales, weights, measures and accounts at the same time, and that such persons shall make no unnecessary interference with the use of such scales, machinery or apparatus.

SEC. 18. The provisions of this act shall not apply to or affect any coal mine in which not more than ten men are employed at the same time: Provided, that on the application of the proprietor of or miners in any such mine, the inspector shall make, or cause to be made, an inspection of such mine, and direct and enforce any regulations in accordance with the provisons of this act that he may deem necessary for the safety of the health and lives of the miners.

SEC. 19. The act entitled an act to regulate coal mines and the working thereof, passed April 29, 1872, is hereby repealed.

SEC. 20. This act shall take effect and be in force from and after its passage.

Passed March 21, 1874.

SECOND ANNUAL REPORT

OF THE

STATE MINE INSPECTOR,

TO THE

GOVERNOR OF THE STATE OF OHIO,

FOR THE YEAR 1875.

COLUMBUS:
NEVINS & MYERS, STATE PRINTERS.
1876.

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VHCA

ANNUAL REPORT.

COLUMBUS, OHIO, *December* 31, 1875.

To His Excellency WM. ALLEN, *Governor:*

SIR: I have the honor to herewith submit my second annual report of the condition and operations of the coal mines of the State, including such other matters and information in connection with mines and mining as I have deemed of importance. At the end of the report I have made a tabulated statement of the number and causes of all fatal and serious accidents during the year; also, a tabulated statement of the coal production of the State, as carefully prepared as I can make it with the means at command.

Many of the coal companies, and their superintendents, refuse or neglect to furnish information at the time of the occurrence of both fatal and serious accidents, there being no penalty attached to the law for failure to comply with its provisions in this regard, and all the accidents are not reported as promptly as they occur.

A large number of accidents occurring in mines are caused by falls of roof and coal in the working places of the miners. Such accidents are generally the result of causes for which the coal companies, or their agents, are in no wise responsible. They are due to the perils of the mine, and their number can only be lessened by increased care and skill on the part of the miners themselves. In his working place, the miner has absolute control, except in furnishing prop-wood, and any neglect on the part of the mine-owner to furnish prop-wood ought to render him responsible for accident; but in the matter of excavating the coal, and securing the strata overhead—work ever fraught with more or less peril—the miner alone is responsible for accident occurring to himself, and no one but himself can assume such responsibility. In providing against all other dangers, however, the miner must rely on others. The timbering of the slope, shaft or drift; the machinery for raising and lowering the miners; the safety of the traveling-ways from the bottom of the mine to the distant chambers in the interior; the sweeping away of the foul gases, etc., are in the hands of the managers of the mine, and the miner has no power to remedy any existing defect or danger in any of these arrangements. Even if he had the power, he has no means of knowing that there is danger, for his business is to hew out the coal at the wall faces, not to inspect the mine.

Although all good mining engineers hold that it is true economy to provide and maintain elaborate arrangements, from the commencement of underground excavations, for the security of the mine and the health and safty of the miners, it requires immediate outlays of money to do this, which too many coal companies and their bosses seek to evade. A small ventilating furnace is constructed, where a large one is needed, to save brick and fuel; narrow air-ways are driven, or air-courses are neglected altogether, because it costs money to provide more timely and elaborate arrangements for the maintenance of a vigorous and healthy ventilation. A single mode of entrance and exit is made to the mine because it costs double the money to make two.

When the law providing for official supervision of the mines was enacted, a large number of the mining operators of the State seemed to regard it as an invasion of their rights as proprietors, and asserted that its operations would result in crippling the mining industry of the State. This fear arose from a want of true mining knowledge. The great majority of these operators, although having invested hundreds of thousands of dollars in mining concerns, practically know nothing of the inside departments of mines. They seldom venture into the interior, and when they do, have to be led through the many labyrinthian passages by the mine boss, or by some other subterranean guide, as a child in a strange city has to be led by its father. This is practically the case in the shaft-mining regions, and where the coal seam is so thin as to cause the explorer to assume a stooping position the whole length of the way. The law came not to impose oppressive restrictions on the business of mining, but to put into practice improvements in the art of mining, which would be to the benefit of both parties in interest; for all experience goes to prove that money spent in making a mine safe and healthy is, after all, money saved. The requirements of the law are no more than the application of approved mining knowledge, which seeks to save, not to destroy. Not a few of the miners also had equally selfish and mistaken views in regard to the object of the law, and the manner in which it should be enforced. They looked for and demanded immediate and uncompromising interposition on the part of the Mine Inspector, overlooking the fact that time was necessary to make needed improvements, and that in many cases the parties in charge of the mines had to be instructed in sound principles and good practice before the law would avail.

During the year many noteworthy improvements have been made in conformity with the law, and no mine has ever been made safer or healthier to the regret of the owners or the responsible managers. There is a growing desire to drive double entries for ventilation, and all the new mines opened during the year, and since the law went into operation, have been laid out on this plan. On the other hand, there is yet a large number of mines in which too little improvement has been made, and if they are not in better condition at the time of the next visit, I shall be obliged to apply to court to enjoin or restrain them from operating with more than ten men at once, until they comply with the requirements of the law.

During the year one third of the mines were not visited at all for want of time. There are nearly three hundred different openings in the State that come under the provisions of the statute, and no one man can get round them all, and make a thorough and careful inspection of their condition, in less time than fifteen to sixteen months; and even then he must be constantly in the field. Mines which I knew, or had good reason to believe, were in a safe and healthy condition were passed over, and attention given to those requiring inspection and improvement.

In passing over the mining regions of the State, I have invariably urged the miners to communicate with me freely, and to promptly inform me, in all cases, where the law was not being carried out; to write nothing but the facts, and to sign the name of the writer to the letter. I frequently receive anonymous communications containing complaints, the writers setting forth that if their names were known they would be discharged. In most of such cases investigation has proved that a private grudge lay at the bottom of the complaint, and I have resolved to give them no attention in the future. No man has ever been discharged for writing me. Indeed, a coal company could not make a greater mistake than to discharge a man for doing so.

COSHOCTON DISTRICT.

In the month of January I received a letter from a miner working for the Home Coal Company, in Coshocton county, complaining of bad air, and asking for an inspection of the mine. The air was found to be very bad, and I directed the superintendent to make the necessary improvements. He promised to do so, but, on my leaving the premises, neglected the matter, and I soon received a second complaint. The superintendent, himself a practical miner, and one of the owners of the mine, urged that the miners were unreasonable, and that there was no cause of complaint. I requested him to accompany me through the mine, which he did, and he not only acknowledged that there was good ground for complaint, but went resolutely to work to improve the condition of the mine. I urged him to change his system and drive double entries, but he declared that the margin on the coal was too small to meet the increased expense. He, however, built a new and improved ventilating-furnace, overhauled all the air-passages, closed up all the leaks, and so improved the ventilation that the miners felt satisfied and grateful. I made a second visit to the mine during the summer, and its condition was still very praiseworthy.

The mine of the Coshocton Coal Company was also inspected at this time, and there was bad air prevailing. The mine had been idle for some time, and had lately received a new mine boss. He promised that arrangements would at once be made for the proper distribution of the air, and that all cause for complaint would be removed, which was done.

The Pen Twyen mine was provided with an abundant supply of air, but it was not as well carried around the mine as it should have been. Several of the entries were too far ahead in the fast, and the miners were working in an impure atmosphere.

Some mines were working at Franklin Station, on the line of the Pan-Handle Railroad, but they were not inspected, and several others of the district were idle at the date of visit, and were passed. All of the mines of this district make white-damp, a gas amidst which a miner's lamp will burn with great clearness, even where the miner himself could not live an hour. This gas comes from the gob-waste, the slack-coal of which contains the elements of spontaneous combustion or " breeding fires."

The coal on which these mines are opened is from three to five feet of thickness, and is a bright, clear coal. It is located as No. 6 by Dr. Newberry, but I am disposed to believe that it is a bed lower down in the series, and is the equivalent of No. 4 of the geological nomenclature. The horizon of No. 6, as it seemed to me, was fully one hundred and thirty feet higher, and as the strata above the coal, in course of extraction, was less than this thickness, No. 6 has no existence in the district. From eighty to ninety feet above the Coshocton coal there is a thin bed near the top of the hill, the equivalent of No. 5, and the place of No. 6 would be about fifty feet higher up.

The mines of this district are opened on a synclinal curve of the strata. The main entries are pushed forward in the lowest place of this hollow, where the height of seam is greatest, and the means of drainage the most perfect.

THE DENNISON DISTRICT.

The mines of this district are located in the Tuscarawas valley, mainly on the line of the Pittsburgh, Cincinnati and St. Louis Railroad, and on the Cleveland and Tuscarawas Valley Railroad. They are all level-free, with the exception of one shaft 110 feet in perpendicular depth, which is not running at present. Three different seams of coal are opened, Nos. 4, 5, and 6. The shaft alluded to above is opened in No. 4. The block-vein colliery is opened in No. 5, and all the others are in No. 6. The system of working the mines in general practice is the same rude and faulty one prevailing in many other regions of the State—that of driving single entries, and relying for ventilation by opening cross-cuts through the rooms. The result is that here, as elsewhere, the entry-men, and all the other workmen opening rooms, seldom have air fit for the abode of the miner. After the rooms are fairly opened, if doors and stoppings are timely provided, the air may be above complaint, but it is never as pure and sweet in the entries as it ought to be. The object in working a mine on this plan is to save the cost of driving air-ways or double entries. When every disadvantage is considered, and the expense added of hanging and keeping up trap-doors, there is no real saving effected. Every mine superintendent who has adopted the system of driving two entries on parallel lines, and keeping them well abreast, is so well satisfied with the change that he could not be induced to return to the primitive method.

The mines of O. Young & Co., at Pike Run, opened on the single-entry system, were in as fair condition as such mines generally are, but the entry-men had no air. Their lights could be maintained with difficulty, owing to the presence of black-damp in the mine atmosphere. I suggested to the pit boss to stop several of these places until a better atmosphere was provided, which he did. I urged him to adopt the plan of taking two entries forward instead of one.

The Andreas mine of S. W. Andreas & Co., near the village of Urichsville, was opened up on a different system from that of any prevailing in the State. The entries had all been pushed to the boundary of the coal property before any of the rooms were opened. The mine was then laid out in a series of blocks, by cutting galleries for air and drainage from one butt entry to another. The blocks at the extremity of the mine were first worked. After the rooms were finished the pillars were attacked, and the roof allowed to fall down. In this manner fully nine-tenths of all the coal was being recovered. The great drawback to this plan is the time required to drive the entries to the extremity of the coal property before any returns are made on the capital invested, and this disadvantage will always forbid its general application.

The mines of the Stillwater Coal Company were not in operation at the date of my first visit to the Dennison district, but on the second visit were inspected. They were in fair condition, or changes were in progress to make them so. None of the other mines of the district were working, and so were not examined

Near the village of Port Washington the Glasgow and Port Washington Iron and Coal Company have opened two coal mines, one on No. 6 and one on No. 7. The blackband ore is mined in connection with No. 7, the ore forming the roof of the coal. Neither of these coals at this point have proved to be well adapted for smelting the ore, even after being coked, and this company was using Connelsville coal in their furnaces.

THE STEUBENVILLE DISTRICT.

These mines refer to the shaft openings in the neighborhood of Steubenville. They range from 180 to 261 feet of perpendicular depth, and are the deepest coal mines in the State. A single visit to this district is sufficient to know that they are well and skillfully managed. The underground workings are modeled after those of the Newcastle district of England—a coal-field in which the art and science of coal mining is better understood than in any other coal region of the globe.

The mines of Steubenville make fire-damp, but so perfect are the ventilating arrangements that the gas is diffused through the atmospheric air and swept away as rapidly as it is evolved from the coal strata, and its presence is seldom seen in any of the working places of the miners. The mines are, however, examined every morning by a corps of experienced fire-viewers before any of the miners are allowed to descend, and nothing is left to miscalculation or to accident. Timely and elaborate arrangements are made for the creation and maintenance of an abundant supply of air to all the ramifications of the mines. The furnaces, air-passages, up-cast and down-cast arrangements, are all roomy, and bear proper proportion to each other, so that the best results are attained. The miners never complain of bad air in this district. The underground manager of the Boreland shaft reported 46,000 cubic feet of air per minute as circulating through the mine, the underground force being less than 100, making a column of air of 250 cubic feet per man per minute.

The Rolling Mill shaft and the shaft of the O. and P. Coal Company have also strong currents of air moving through the mine. They were not measured, and so the amount can not be given, but it was all-sufficient. The Rolling Mill shaft has a furnace and the exhaust steam from a No. 6 steam Cameron pump to produce rarefaction; the O. and P. shaft a furnace; the Furnace Company's shaft exhaust steam alone—too weak a power for a large mine—(this was a new opening, however, and the force of men was small at date of visit); the Mining and Coal Company a furnace; the Boreland shaft a furnace; the Bustard shaft a furnace; the Mingo shaft a furnace; La Grange exhaust steam (a new mine); and Rush Run a double furnace. All these furnaces were unusually well constructed, and the fire constantly maintained.

The manager of the Stony Hollow shaft and the Market Street shaft has sent me a monthly report of the amount of air in circulation. These two mines, belonging to one firm and managed by one engineer, are three-fourths of a mile apart, and are holed through on each other, one serving as a down-cast, the other as an up-cast shaft.

The following is the monthly statement, being equal to 500 cubic feet per minute per person employed:

January	65,000	cubic feet	per	minute.
February	62,824	“	“	“
March	55,940	“	“	“
April	59,070	“	“	“
May	50,060	“	“	“
June	48,640	“	“	“
July	50,456	“	“	“
August	56,570	“	“	“
September	62,990	“	“	“
October	67,212	“	“	“
November	68,925	“	“	“
December	53,250	“	“	“

None of the other mining bosses have sent me monthly reports. All bosses in charge of mines in which fire-damp abounds are required to do so by the statute, but as there is no penalty attached for neglect or refusal, it is simply optional with them whether they do so or not.

Mingo's shaft, situated below Steubenville, works a very small force of men, and does not come under the act at present. The mine is well opened, and has ample ventilating power, though it has but one means of ingress and egress.

The shaft of the Steubenville Furnace and Iron Company had also but one means of exit; but at the date of visit the excavations were not equal to what the law requires before two openings must be provided.

Further up the river there are two abandoned shafts lying full of water. Both of these openings have been filled up, and no record of the excavations has been preserved. It is thought that in one pit about three acres of coal have been mined, and in the other about one acre. If the Furnace and Iron Company propose using any of these shafts for a second opening, they should reopen the pit, pump out the water, and work from both shafts. Unless the water is pumped out, great caution will be necessary in working forward toward these old works, and bore-holes should be kept in advance of the excavations as a measure of safety.

The Furnace shaft has been sunk on the ancient bed of the Ohio River. Although one hundred and ten feet deep, it has only about twelve feet of shaly strata above the coal. The Company have unwisely commenced mining out a section of the coal near the bottom of the pit. Where there is so light a cover, all this coal should have been left until the mine was being finished up. A break in the roof in this excavated portion might discharge such a current of water as to submerge the colliery and imperil the safe exit of the miners. All the workings in this part of the mine are now suspended.

The ventilating power of this mine is the exhaust steam from the steam-pump placed at the bottom of the shaft. This power will be wholly inadequate in summer weather as the workings extend, and as it would be impossible to use a furnace, owing to the wood-work of the shaft reaching nearly to the bottom, an exhaust fan ought to be applied, if the present upcast compartment of the shaft is to be used in future.

Two other mines, the Bustard shaft and the Allikanna shaft, both of which were idle during my former visits to this region, are now at work. They have each but one opening, but they are at present working a very small force of men. It has been proposed to drive through from the Bustard shaft to the Furnace shaft, to provide double means of exit to each of these mines.

On the cages of the Rolling Mill shaft there were two different kinds of safety-catches, both patented since the passage of the mining law. I made four thorough tests of each, and they proved entirely satisfactory. Either of these catches may be applied to a coal shaft with entire confidence. I shall make further tests from time to time, and prove, by actual practice, the length of time they will run before the springs require to be renewed.

The Market Street and Stony Hollow shafts are holed through in each other, which make double outlets. The Rolling Mill shaft, the Ohio and Pennsylvania shaft, and Boreland's are all through in each other. The workings of the Rolling Mill shaft have been pushed under the Ohio River, but they are now abandoned in that part of the mine because of the danger of the river bursting in and drowning the colliery.

The shaft of the Rush Run Coal Company has also but one opening, but the superintendent of the mine had, before the time of my visit to the district, reduced the working force of the mine to ten men, until such time as the two openings would be provided. Part of the workings of this mine also extend under the Ohio River a distance of fifty yards or more.

The shaft at the village of La Grange, owned by Messrs. Lowe & Spaulding, and superintended by John Lowe, has also but one opening. It is, however, a new mine, and does not come under the provisions of the law. This is the deepest coal shaft in Ohio, being two hundred and sixty-one feet of perpendicular depth. It is lined throughout its whole length with wood. The cages are covered, safety-gates provided, and a speaking-tube applied. The coal of this mine is upward of five feet high, while at Rush Run, further down the river, it is still higher, locally rising to seven and eight feet.

The mines of this district are all opened, it has been thought, in one seam of coal (No. 6 of the Geological Survey). This is the view held by Dr. Newberry. While it is with extreme diffidence that I venture an opinion at variance with that of so able a geologist, I would suggest that the Rush Run and La Grange shafts only are opened in No. 6, and that Mingo's, Boreland's, the Rolling Mill shaft, and the other shafts in the neighborhood of Steubenville, are sunk in No. 7. At the Stony Hollow shaft of the Steubenville Coal and Mining Company the seam is nearly four feet in height; at Boreland's it is only three feet five or six inches; and at Mingo's it has thinned down to twenty-six and twenty-eight inches. In the La Grange shaft, the next one below Mingo's, there is a seam of coal fifteen inches in thickness twenty six feet above the bottom of the five-feet coal. This upper coal I regard as the equivalent of Mingo's, Boreland's, the Rolling Mill shaft, etc. Forty-four feet below the coal of the Rolling Mill shaft there is another seam four feet four inches thick, to which the mine-owners have sunk within the last six months; and this, it seems to me, is No. 6, the equivalent of the La Grange shaft coal and of the Rush Run shaft coal—No. 7 having thinned out to a mere trace at Rush Run.

The Mingo Iron Works Company, the owners of the Mingo shaft, have driven entries in all directions in thin coal, hoping to strike a thicker field. They have been encouraged in this hope from seeing a workable seam of coal in Boreland's, on their right, and a workable seam at La Grange, on their left; but if the thin coal, near the bottom of La Grange shaft, be the equivalent of Mingo's and Boreland's, it will be to no purpose to make further explorations in this seam, but to explore by sinking for the equivalent of the coal of La Grange shaft and the lower coal of the Rolling Mill shaft, which should, and doubtless does, exist at a depth below the bottom of the Mingo shaft of from twenty-six to forty-four feet. Even should No. 6 be wanting at this point, which is highly improbable, for it is every where a very persistent seam, there is still hope for finding other coals by going deeper.

BELLAIRE DISTRICT.

This coal region includes the mines opened along the Ohio River in the Pittsburgh coal, or No. 8, beginning with the Walnut Hill mines of the Ohio and Pennsylvania Coal Company, at Tiltonville, Jefferson county, extending thence twelve miles below Bellaire to the mines of the Union Coal Company, in Belmont county. The Ohio River flows along the dip of the Coal Measures. The Tiltonville and neighboring mines are high up in the hills fronting the river, while the Union and Pipe Creek mines are below the bed of the Ohio.

The Walnut Hill mines of the Ohio and Pennsylvania Coal Company, at the date of inspection, April 10, were in a deplorable condition in regard to ventilation. The miners had been compelled to stop off work for want of air; and so defective was the ventilation, that a lamp could with difficulty be kept burning in nearly every working place. The mine had two openings, but had no means of creating a flow of air, except the natural forces; and the interior of the mine had no proper arrangements for distributing the air at the working faces. The superintendent of the mine was busy erecting a furnace at the outside of an old opening. The grate of this furnace was too small for any good results, and the passage-way of the chimney for the ascending column of heated air was less than a foot square. I informed him that such a structure would serve no purpose whatever—that he was simply spending time and money for nothing, and urged him to commence the sinking of an air shaft at once, and at the bottom of it erect a large and spacious ventilating furnace. He, however, went on with his present arrangement, and when it was completed there was still no flow of air in the mine. Even if this rude furnace had given any motion to the air, the working places of the miners would not have been benefited as they should have been, for want of the necessary arrangements to discharge the current at the working faces where the people are employed.

I wrote to the general superintendent of the company in Cleveland, urging him to send the manager of the Ohio and Pennsylvania Coal Company's shaft at Steubenville, Mr. John Smurthwaithe, to superintend the ventilation, and to give him charge over all the ventilating arrangements of the mines of the company. Mr. Smurthwaithe was one of the best practical miners in the State, and was especially skilled in mining ventilation. He has since died, and in his death Ohio has lost a man of whom there are too few to be found. This worthy man was equally skillful in the management of miners, by whom he was highly regarded. Throughout the whole of the Steubenville district there is less bickering and fault-finding with the mining captains on the part of the working miners than in any other mining region in the State, and this fact is to be attributed to the superior ventilation prevailing. Amidst the foul and noxious elements of the mine, what miner can respect that captain whose duty it is to keep the air clean and sweet, and allows it to be for ever foul and poisonous?

The Rainey mines were inspected by the proprietor's request during a second visit to this region. The ventilation was good, and proper means of ingress and egress were provided. These mines had been leased for some years previous to a firm in Cleveland, and a number of the rooms had fallen in, caused by a crush of the rocks overhead. The safety of the miners was assured in case of any sudden and immediate falling in of the mine. The falling of the roof in the rooms was due to a local crush of the overlying rocks. In accordance with the prevailing system of the district, the rooms were made wide and the pillars narrow, with the object of finishing up the mine in the first stage of working, and leaving all the pillar coal unwrought, to be lost for ever.

The mines of Heatherington & Brothers, near Bellaire, are more systematically managed than any others, both as regards ventilation and the ultimate recovery of the coal. The air is exceedingly well distributed, and the miners expressed gratitude for the sanitary condition of the mine.

Several mines are opened on the line of the Baltimore and Ohio Railroad, west of Bellaire. They are drift openings. Kidd's mine was examined. It worked fourteen men, had a fair state of ventilation, and was in other regards secure. There is a slip-dike in this mine, which throws up the coal three feet. This fault, although of little depth, compared with slip-dikes in many coal fields of the world, is one of very unusual depth in Ohio, and is the largest I have seen in any coal mine in the State. Another mine, west of Kidd's, working more than ten miners, was visited, but was not inspected.

The Pittsburgh Works, the Weegee mines, the Union Coal Works, and the Pipe Creek mines are all slope openings, situate below Bellaire, on the Ohio River. They were all visited and inspected. The Pittsburgh slope was being pushed towards a point with one of its galleries, in order to get a shaft sunk in suitable ground for a double mode of ingress and egress, and to provide better ventilation. The owners of the mine proposed to put a stairway in this shaft. The mine had two openings already, but the air-shaft, although situate more than one hundred feet from the bottom of the slope, came up directly by the side of the slope mouth, and as the wooden structures covering the hoisting machinery were near the slope mouth, there was no guarantee of safety in case of fire in these buildings, but when the new air-shaft is completed there will be approved means of egress in case of accident, and also an improved ventilation.

The slope of the Union Coal Company is one of the most skillfully opened mines in the State. The entrance to the slope mouth, and the passage downwards to firm and rocky strata, are secured by an arch of stone masonry, substantially erected, and the passage-way of the slope is double. The length of the slope is 428 feet. The air-shaft of this mine also bore marks of skillful and prudent workmanship. The passage to the ventilating furnace was lined on both sides, for several yards, by a wall of stone masonry, to prevent the possibility of the pillars taking fire from the heat of the furnace.

The Pipe Creek mines, situate at the mouth of Pipe Creek, are the lowest openings on the Ohio River, of the Bellaire district. This mine was working about thirty men at date of visit, was provided with two openings, but, as at the Pittsbugh Works, the mouths of the slope and air-shaft are too near each other for safety. The ventilation was fair.

The manner of laying out the workings is generally very faulty all over this district. The rooms are made too wide and the pillars too narrow. The ultimate result will be, in many cases, a crush or creep of the mine excavations, which will overrun and destroy the whole economy of the underground workings. The overlying strata is 500 to 650 feet thick. To support this mass, pillars no more than eight and ten feet thick are left, while the room-workings are made from twenty-four to twenty-six feet wide. No value is placed on this pillar coal, the main concern with all the companies being to get out coal as cheaply as possible in working forward, without regard to ultimate consequences.

The dip of the Coal Measures is quite marked in the mines of the Bellaire district. It is south 82 degrees east, and exceeds 40 feet to the mile. Rooms can only be turned from one side of the butt entries, by reason of the dip.

The Pipe Creek mines are opened at the foot of one of the highest hills in Belmont county. I spent several hours on the mountain side, noting the number and thickness of coal beds above the Pipe Creek mine, opened on the Pittsburgh coal, and found a bed of coal from three to four feet thick, sixty-three feet above the Pittsburgh seam, resting on a floor of limestone. This is a local bed, and the coal is very impure, having two layers of slate running through it. The lower stratum, three inches thick, was composed of fire-clay; the upper stratum was two inches thick, and was black shale. The immediate cover of the coal was a stratum of iron ore, but both the coal and ore appeared to be very irregularly deposited. Fifteen feet above this coal there is a four-feet seam, in a homogeneous mass, and of good quality. The horizon of this coal is well marked at Bellaire, where it is exposed to full view on the bluffs fronting the river. One hundred and twenty-five feet above this four-feet coal there is a good block coal, three feet in thickness. This is also a pure and homogeneous seam, entirely free from slate; it appeared to be a coal of superior excellence. Ninety feet above the three-feet coal there is another block coal, four feet thick, the upper two feet of which is a splint coal, and burns into a white shale, but the lower two feet are of admirable quality. This makes four workable beds of coal above the Pittsburgh seam, besides a number of small seams, two of which, as seen in the passage-way of the slope, measured about a foot each.

The following is the material as seen, and thickness of same, beginning with the Pittsburgh coal in bottom of mine:

Coal	5¼ feet.
Shale, sandstone, and limestone	63 "
Coal	4 "
Rock and slate	15 "
Coal	4 "
Limestone and rock	150 "
Block coal	3 "
Slate and rock	93 "
Coal, top part splint	4 "
To top of hill (material not examined)	200 "

THE POMEROY REGION.

All the mines of the Bellaire region on the Ohio River, below the Pittsburgh Works, as already stated, are opened below the level of the bed of the river. This seam of coal never reappears above water again until we reach Minersville, in Meigs county.

The first opening in the Pittsburgh seam in the Pomeroy region, in descending the river, is the Antiquity shaft, near the village of Racine, in Meigs county The shaft has not been visited because, since the passage of the mining law, it works less than ten men at once, and consequently does not come under the requirements of the law. It has but one opening, and is two hundred feet deep. The owners have assured me that a second opening will be provided before more than ten men are allowed to work in the shaft. The two mines at the village of Syracuse, one a shaft and the other a slope, have double outlets. The shaft has covers on the cages, and safety-gates on top, also safety-catches. The ventilation has been improved by the erection of a large and substantial furnace, erected since my first visit to the mines.

I received complaints during the summer of bad air prevailing in the Pamunky mine, but on visiting the district shortly afterward, the mine was idle and was not examined. I called the attention of the superintendent of the Pomeroy Coal Company to the facts, who promised to see that all cause of complaint would be removed. This mine, although owned by the Pomeroy Coal Company, was leased out, the lessees agreeing to work the mine according to the requirements of the mining law.

In my last report I alluded to the system, long in practice, of driving double entries in the mines of the Pomeroy district. Since the law went into effect, the underground manager of the Pomeroy Coal Company's mines has suggested an improvement in the plan of ventilation The ordinary practice was to carry the air forward along one butt entry, and return it by the other, allowing it to diffuse through the room workings by break-throughs or cross-cuts, made from one room to another after the rooms had been advanced forty yards. The proposed improvement is to take the air off the entries as soon as cross-cuts are made from one room to another, and carry it along these cross-cuts. By this arrangement the moving current of air will be forty yards nearer the working faces in the last stages of work. As the rooms are driven up eighty yards, and but one break-through is made on the way, there is often defective ventilation, particularly in the rooms opened on the return, where the miners get the air loaded with all the impurities collected in its passage from the first workings.

The general superintendent of these mines, Mr. Horton, desires to see all improvements applied for the safety and comfort of the miners. The system of driving too entries along side of each other, to improve the ventilation, was first applied at Pomeroy by Mr. Heckard, the resident mining engineer of the mines, before it was thought of in any other region of the State.

The Pomeroy Coal Company, at their six mines, employ nearly seven hundred men and boys, when the mines are in full running order. This force is divided up as follows:

Miners cutting coal	[illegible]
Miners, roadmen, drivers, etc	[illegible]
Outside hands	[illegible]
Total	[illegible]

At the present time this force is not employed, and one of the mines has been idle altogether for nearly two years. During the summer months, when the river is too low to ship coal, and during the winter months, when it is frozen up, the mines are laid idle altogether. The miners do not average more than seven months' work out of the twelve, but when they are working they generally make good use of their time.

THE IRONTON REGION.

The mines of this district are found in Lawrence county, and are opened on the lower Coal Measures, in Nos. 6 and 7 of the geological nomenclature. The Bellford mines of Norton Bros. & Co., two in number, were visited and inspected during the month of July. They are both drift openings. The coal is from three and a half to four feet thick, and is doubtless the equivalent of No. 6. Double outlets are provided, and furnace ventilaton applied. The air was not as good in many of the places as it should have been, and the old, rude, bad practice of working forward by single entries prevails. While, under this plan, it may be possible, with ceaseless vigilance and a vigorous current of air, to keep the entries and forward rooms in a fit state for men to work, that ceaseless vigilance and vigorous current are never provided. And all over the State, where single-entry work prevails, there has heretofore been bad air in the entries, and bad air in the head-rooms; oftentimes so bad that no man could work longer than five and six hours a day. This system of working by single entry, and with a feeble ventilating current, almost invariably go hand-in-hand.

The Lawrence mines of the Lawrence Iron Works were also inspected. The ventilation was provided by the natural forces, and it was better in this mine, but at the face of the entry-workings was defective. The coal of this mine is the equivalent of the Bellford mines, and is of the same quality and thickness. Another mine of this district was visited, but as it was idle at the date of visit it was not examined. There are two or three other mines besides those named in operation in this vicinity, which have not yet been visited. All these works are drift openings, and have double means of exit and entrance. The ventilation is the only requirement of the law which needs improvement; but in drift-mines, as in slopes and shafts, it is the most important one. Drift mines are worse ventilated, as a rule, than shafts.

THE JACKSON REGION.

These mines are all shaft openings, sunk on the lower coal of the series, the equivalent of the Mahoning Valley coal. None of the mines exceed one hundred feet in depth, and they are all provided with several means of exit, and with ladders in one of the shafts for the egress of the miners. The coal is used in the blast furnaces of the district as it comes out of the mines, there being usually a blast furnace alongside of the coal shaft. Usually not more than twenty-five or thirty men work in any one of the mines in the neighborhood of Jacksonville—just force enough to run a furnace.

At Wellston, eleven miles north of Jackson, on the Portsmouth branch of the Marietta and Cincinnati Railroad, two shafts are in active operation, one of them having been sunk since the law went into force. The shaft of the Milton Furnace and Coal Company has now a second outlet provided. It is a shaft in which a good and substantial stairway has been placed, and the miners can descend and ascend at pleasure. The mines of this district are generally safe. As they employ but a small force of men there can be no excuse for bad air in any of them, the means of ventilation being of easy command.

In the mines at Jackson Court-house the coal lies on the ground in hollows and arches, forming a series of synclinal and anticlinal curves. At Wellston it is evenly and regularly bedded. Both coals serve nearly equally well in the blast furnace in a raw state, and because of this quality they have been considered as equivalent seams. I regard the Wellston coal as an upper seam, separated from the place of the Jackson bed by one hundred to one hundred and forty feet of strata. The Wellston coal does not exist at Jackson, because there is not the height of land to embrace it, and the Jackson coal may not exist at Wellston, for it is a very irregularly deposited bed, and is often wanting where it is due.

This region was visited twice during the year, but only the Wellston mines and the Huron mines were inspected.

THE VINTON COUNTY REGION

Includes all the mines in operation along the line of the Marietta and Cincinnati Railroad, between Hamden and the Carbondale mines of Athens county. All the openings are in Nos. 3, 5, and 6 of Dr. Newberry's enumeration. The Vinton Coal and Iron Company's shaft, one hundred and seventy feet of perpendicular depth, is opened on No. 3, the equivalent of the Wellston coal. The coal possesses the open-burning properties of the Jackson county coal, and is fitted for furnace use in a raw state. At the date of visit to this district this mine was idle, and was not inspected.

The two mines of the Zaleski Company are opened on Nos. 5 and 6. Both seams resemble each other in height, and in the presence of two layers of slate which run through the coal, but they are independent seams, and are separated from each other by about seventy feet of strata.

The lower coal, opened near the village of Zaleski, splits in two within a foot of the roof, and the separated parts continue to diverge along the east entry until the wedge of slate which divides them has increased in thickness to twelve feet, forming two seams.

Both mines of this company are drift openings, and neither of them were very well ventilated. The mine of the lower coal made black-damp more abundantly than any other mine I have yet examined in the State. There was quite a vigorous current of air moving along the air-gallery, and it was brought forward within a few yards of the inmost room, yet so abundant was the black-damp that the light could only be maintained by moving slowly, and holding the lamp downward. In such an atmosphere a miner had been working during the fore part of the day. I directed the boss to find him another place, and stop the room until fresh air could be brought forward to renew the circulation. Double outlets were provided at both mines.

The Buckeye mines of the Ingham Coal Company, at King's Switch, situate in Athens county, are opened in No. 6, and were found in good order. The openings are level-free.

The works of the Carbondale Coal Company are also in Athens county. They are drift openings, and were in fair condition. The coal is also No. 6. These mines were opened many years ago, and were made the subject of two experiments, still unknown in successful practice in this State, that of excavating the coal by a coal-cutting machine, and opening and working the mines by the long-wall system. Both experiments proved failures, so far as reducing the price of mining was concerned, which was the object sought to be accomplished. The seam of coal is well adapted to long-wall work, but the pack-walls, instead of being of mine refuse, were made of hewn timber of more value than the coal pillars needed for supporting the mine, and the coal-cutting machine required more hands to operate it in cutting a ton of coal than would be required by manual labor. The successful application of coal-cutting machines in mines is, however, only a question of time. The miners may look with disfavor on their introduction, but they will come as their best friend, for they will take much of the exhausting manual labor off the shoulders of the miner.

These mines are now in a fair state of ventilation, and work a large force of men. The coal is thinner than it is in the mines of the Hocking Valley opened on the same bed.

THE HOCKING VALLEY

Includes all the mines operated along the Hocking River between Athens and Logan. The mines are all level-free, except three shafts at the lower end of the district, two of which work less than ten men. The mines are operated on No. 6. Those furthest up the valley, as Brooks's, Laurel Hill, Lick Run, and Hayden's mines, operated near the out-crop of the coal seam, have abundant means of ingress and egress among the numerous ravines which cut down through the coal. The system of opening up the mines is by single entry, and reliance is had for air by driving the entries through the hill, and trusting to the natural forces for the necessary current of air. Where the surface conditions forbid getting a second outlet through the hill, an air-course is driven along the face of the coal from one butt-entry to another, to cause a circulation. An effort is made to keep the miners working in rooms on a range of work swept by a current of air, and to have the air entry drivers alone working in the part beyond the reach of the current. By this arrangement the men in the rooms have generally, but not universally, a fair supply of air. The workmen in the entries, however far advanced in the fast, have not and can not have good air.

As the roof of the coal of these mines is generally hard and firm, and the superincumbent strata quite light, the rooms are worked twenty-four to forty feet wide, and the pillars are only eight and ten feet thick. After the rooms are worked this pillar of coal is left standing, and is lost. If double entries were driven on the face and butts alike, with strong pillars between each entry, to be pierced only for air, and the room pillars made strong enough to break a crush of the strata in working backwards, 95 per cent. of this coal might be recovered, and better ventilation would prevail. A ventilation relying on the natural forces alone is subject to the season, as a ship is subject to the wind. Artificial ventilation by the furnace or fan, when all the necessary arrangements are complete, is like a steamship, and can defy the wind or season. The true miner never complains of the season, but defies and controls it.

The mines at Lick Run were in a bad state in regard to ventilation. There are two main openings, one of which had no return for air, and the miners were suffering. The face of the entry, however, at the time of inspection, was nearly forward to a cross-air course driven from the other mine, and when this was reached the desired result could be attained. The other mine had an up-cast shaft, constructed of wood, near the mouth of the main entrance. In this shaft an iron fire-lamp or basket was kept burning during the day, and gave a little motion to the air, but some of the room-workings were unfit for the abode of the miners. I urged the mine-owner, Mr. Scott, of Nelsonville, to drive double entries, and to sink an air-shaft at the back of the workings, establish a furnace at the bottom, and carry an abundant supply of air through the mine.

The existing arrangements would suffice until these improvements are provided.

Poston's mines and those of the Nelsonville Mining Company are holed through in each other, and one serves for receiving and the other for discharging the ventilating current of air. The entries are all single, but air-courses are driven on the face of the coal from one entry to another, where there is no opportunity of getting out to day-light. The arrangements for ventilation were good in both of these mines.

The Nelsonville Mining Company, as observed in my last annual report, is a sort of co-operative concern, and, so far, may be said to have proved a success. Many of the original owners of shares have sold out, but new men have been found to buy their interests, and the mine has run steadily and had a good share of the coal trade since the first shipments were made, nearly a year and a half ago.

In Longstreth's mines, situated one mile below the village of Nelsonville, the cover of the coal is thicker than at Hayden's and Brooks's, and there are not as many chances to get out to day with an entry. The mines, two in number, both in communication with each other, are laid out in a series of blocks. The butt-entries are single, and are four hundred and fifty feet apart. The air-entries, driven from one butt-entry to another, are also made about four hundred and fifty feet apart, ten rooms being contained in each block. In these mines the pillars are recovered as the workings progress forward. After the rooms of a block are finished, the pillars are attacked. The entrances to the mines are made very narrow, to add strength to the entry and to break the crush which follows the removal of the pillars. But with this precaution the entries are not strong enough, and last summer a crush of the strata, which followed the extraction of the pillars, threatened to overrun and close it, and was only prevented from making a total wreck of a valuable and extensive portion of the mine by building a number of shanties (pillars of wood) and by timbering the entry at great expense. If the entries of this mine had been double, with a strong pillar between them, the crush would have been powerless for harm. Moreover, very little, if any, saving is made by single entries, as the money has to be expended on the air-courses, driven from one butt entry to another every four hundred and fifty feet, in dividing the mine into blocks, while the air-course drivers have never good air. The superintendent of these mines is one of few in the Hocking Valley who makes any attempt at the recovery of the pillars of the mine. Coal lands are cheap and abundant, and thousands upon thousands of tons of coal are annually lost to posterity, beyond the possible hope of recovery, in abandoned and crushed pillars.

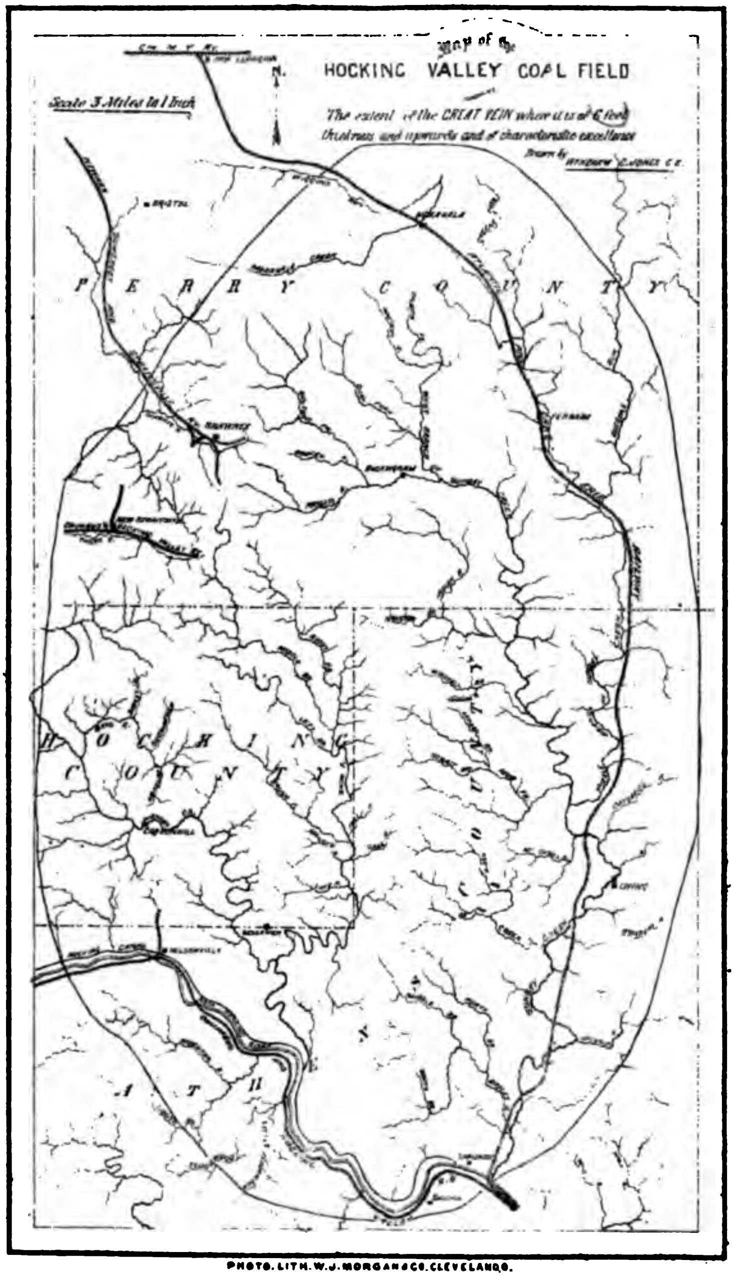
Two miners were killed in one week in Longstreth's mines during the summer. An examination into the cause of the accident, made by request of the miners, did not seem to attach any blame to the mine-owners or to the officers in charge of the mines. The unfortunate men met death in their working places under circumstances beyond the control of the officers of the mines. Just at this time, however, the miners were very much excited, as the crush of one of the entries, referred to above, was then in progress. The falling masses of rocky strata, the squeezing of the entry-pillars, and the creeping of the coal floor, excites the fears of miners, even though their judgment teaches them that there is no cause to fear sudden and immediate danger. A few of the miners, unused to such scenes, seemed to think that the whole mine was about to close.

The mines at Doanville, the property of the New York and Ohio Coal Company, were ventilated by the use of a furnace. It was too small for good results. The miners complained of bad air, and an examination of the mine showed that a number of miners were at work beyond the reach of the circulating current of air. The mine superintendent promised to sink an air-shaft at the back end of the workings, and place a large and substantial ventilating furnace at the bottom of it. I suggested the advantage of driving double parallel entries and carrying the ventilating current along as the workings advanced, instead of the ordinary plan of driving air-courses in the fast, in which men are forever plunged in a stagnant and foul atmosphere. The old primitive mode adopted in the early days of mining, when the subterranean excavations were of limited extent, must disappear before the requirements of the mining law.

The Floodwood mines have several outlets and an air-shaft, and the working places of the miners were above complaint. The ventilation is by natural causes. The coal of these mines, usually five feet nine or ten inches high in the workings, is seven or seven and a half feet at a few points of the mine. This additional height is caused by the union of two coals—by an upper coal, a foot or so thick, coming down and uniting with the main seam. This upper stratum exists at all the mines of the valley, but it is separated from the main seam by a wedge of slate from four to nine feet thick. At the Doanville mines the slate was thinned out to nothing, and the two coals form one seam, making nine feet of coal all over the mine. Northward, towards Straitsville, Shawnee, and Buckingham, the upper coal has increased in thickness to four and five feet, and, remaining united with the main seam, forms the great eleven and twelve-feet vein of Perry county.

STRAITSVILLE AND SHAWNEE DISTRICTS.

The mines of this region are mainly located in Perry county. They are all above the base of the hills. The coal is from eight to eleven feet


Map of the
HOCKING VALLEY COAL FIELD
The extent of the GREAT VEIN where it is of 6 feet thickness and upwards and of characteristic excellence
Drawn by Andrew C. Jones C.E.
Scale 3 Miles to 1 Inch
N.
BRISTOL
P E R R Y C O U N T Y
H O C K I N G
C O U N T Y
A T H E N S

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high. Both of these districts have been opened up within the past five years, and the mining developments have been wonderful. Some of the mines are worked on more approved systems than prevail along the Hocking valley, all the entries being double. The pillar coal can be recovered in mining forward, and furnace ventilation is applied. In some of the mines opened up on the old plan crushes have already occurred, and crushes will yet occur in others, and there will be a fourfold expenditure required to save these mines from total wreck. This would have sufficed to cut double entries and to have left pillars of the requisite thickness and strength. A thick seam of coal, with all other conditions equal, requires stronger pillars than a thin seam to support the superincumbent strata, just as a long prop will break and give way in supporting the roof, where a short one of the same diameter would stand firm.

The mines of the Newark Coal Company, at Shawnee, three in number, are all worked by driving double entries, and have furnace ventilation. The three mines are all connected with each other, and a good state of ventilation prevails. The Lyonsdale mines are also opened in this manner, and have furnace power to cause a movement of air. The Troy mines, at Straitsville, originally worked on the plan of driving one entry and opening rooms from both sides, have changed to cutting two entries. This mine has a good furnace, and at the date of inspection was in a praiseworthy condition, so far as ventilation was concerned. The Plummer Hill mine is opened on the butts of the coal by driving a single entry through the hill. The ventilation is by the natural forces, and sweeps through the mine along the entry where the people are employed. Some of the miners complained to me, that owing to an indiscriminate system of blasting at all hours of the day they were annoyed by the powder smoke. I called the attention of the mining boss to this fact, and he forthwith forbade the use of powder in the mine till four o'clock in the afternoon, and henceforth the mine was kept free from powder smoke and the air kept clean and sweet. Where there is no occasion to blast more than once in a day—and there are few districts in the State where more than one shot is needed—discharges of gunpowder at all hours of the day will pollute the air of a mine ventilated by a single current, no matter how vigorous the current may be. The workmen who get the first of the air are not annoyed, but the powder smoke has to pass the working places of one hundred or one hundred and fifty men beyond, and before the mine is cleared of the products of one blast, another blast occurs, and all the people in the return current are plunged, from morning till night, in an ever-thickening atmosphere.

The old mine of the Straitsville Mining Company is ventilated by the natural forces. On the first visit to the district this mine was idle, but on a subsequent visit it was running to its full capacity, and was inspected. It has several outlets and two or three air-shafts, and the ventilation was good.

The mines of the Central Mining Company, two in number, are holed through in each other, and also to the mines of the Mining Company. There is an air-shaft also. Ventilation was promoted by means of the vent from a steam-pump at the bottom of the air-shaft. One of the entries was driven in the direction of a ravine, and was meant as a permanent air-way.

The Muskingum valley region extends along the line of the Shawnee branch of the Baltimore and Ohio Railroad, between Shawnee and New Lexington; thence along the Muskingum Valley and Cincinnati Railroad to Zanesville; thence down the Muskingum River to Marietta. There are a large number of mines, the greater number of which are opened in No. 6, which, from a gigantic seam of ten and eleven feet in height, at Straitsville and Shawnee, dwindles down to two and a half and three feet in many of the mines of this region. All over this vast area, however, the coal retains certain characteristics—dry and open-burning, and a superior coal for generating steam, for rolling-mill purposes, and doubtless fitted for blast-furnace use in a raw state. Wherever opened, it is also found in three layers or benches, and with two thin layers of fire-clay and shale running through the seam. The upper bench of coal is, however, very thin and impure at a number of points, and is not mined.

Along the Muskingum Valley Railroad, and also along the Muskingum River, the coal is a "block coal," which, after it is undermined, can be brought down without the use of either powder or wedges. The only tools required by the miner are a set of picks and a shovel.

No great force of men work in any of the mines, and the coal is brought from the wall-faces to the outside, not by horses and mules, as in other mining districts, but by the miners themselves, assisted by dogs. The dogs are harnessed up like horses, and pull at the front of the loaded car, the miner pushing behind. One miner sometimes owns as many as three dogs, all of which are harnessed up together in single file. All the mines, except one shaft at Zanesville, fifty feet deep, are level-free, the working force ranging from three to twenty men in each mine.

At New Lexington two seams are mined, Nos. 5 and 6. The same seams are opened at Delcarbo and at Zanesville. The Muskingum River flows along the dip of the coal measures, and the bluffs fronting the river afford a fine field for the geologist. Nos. 5 and 6, which are high up in the bluffs at Zanesville, dip under water before reaching Blue Rock, the coal of these latter mines being No. 7. This seam soon gets under water also. Then comes a long stretch of the barren measures, until No. 8, the equivalent of the Pittsburgh bed, begins to cap the top of the hills. Twelve miles above Marietta, No. 8 also plunges under the river. Above this bed no other seam of the upper coal measures has been opened, and it is possible that none of them exist. The strata in the hills at Marietta resemble the red shales of the barren measures, though they undoubtedly belong to a horizon above the Pittsburgh coal, which lies buried under the waters of the Ohio at least one hundred and sixty feet deep.

All the mines of this region have proper means of exit, passages being cut through the coal in the mine to ravines on the flanks of the mine. The ventilation is left to the unassisted forces of nature, and is often defective for want of driving the necessary air-ways to properly distribute the air. The art of ventilation is not understood. There are sixty or seventy of these small mines in operation in this region, most of which work less than ten men at once, and so do not come under the inspection law.

Coal No. 8 on the Pittsburgh bed is opened and worked at Coal Run. The seam is from three to four feet in height, and has an upper bench, the two coals being separated by a band of fire-clay. This mine was in a dangerous condition at its entrance. The timbers were too weak, and many of them were cracked or broken, and liable at any moment to fall in two. I urged the mine-owner to repair the work at once, which he promised to do, and which he had of his own accord already contemplated.

THE CAMBRIDGE AND DUCK CREEK DISTRICTS.

Along the line of the Baltimore and Ohio Railroad, near Cambridge, in Guernsey county, a number of mines are opened on No. 6 or 7. The coal is fully five feet in height, has a fine roof, but a soft and yielding fire-clay bottom. There is one coal shaft in the district. It is less than forty feet of perpendicular depth; all the other mines are level-free. The older openings of the district were made with wide rooms and small pillars, and have been overrun with creeps—the pillars sinking into the floor and closing up the excavations. More approved systems now prevail, and furnace ventilation is provided. A section of the mines of the Scott Coal and Salt Works has been opened up by driving the rooms on the butts of the coal, an experiment which the manager hopes will lessen the cost of mining, and add to the security of the mine.

Approaching the village of Cambridge from the east, along the line of the railroad, the coal appears to be troubled with "horse-backs," and to be latterly supplanted by a bed of sand-rock, which usurps the place of the coal, leaving no trace of its existence.

Double outlets are provided to all the mines, and the ventilation has been greatly improved in the district, though improvement is still needed.

The Macksburg mines are located along the line of the Duck Creek Railroad, between Marietta and Cambridge, in Washington and Noble counties. The coal is five and one-half to six feet in height; then there are two and one-half to three feet of fire-clay overhead, and above this another seam of coal of varying thickness, but averaging about three feet. This is the Pittsburgh coal, or No. 8, and it here retains its usual purity and excellence. The mines are level-free, and are opened by driving the main entries forward along the face of the coal. The mines are made twenty-one feet wide, and the pillars eleven feet thick. All the openings are provided with double means of ingress and egress, and the ventilation, as far as examinations were made, was fair, though all the mines were not inspected, as they were idle at the date of visit, April 27.

The coal at the Dexter mines is 190 feet above the level of the railroad, and the mines are twenty-six miles from Marietta. About midway between the mines and the Ohio River, along the line of the railroad, the coal dips under water, and at this point has thinned down to three and three and one-half feet.

A number of oil wells have been sunk in the neighborhood of the mines, and some of them were yielding paying quantities of oil. The wells range in depth from 160 to 600 feet. The oil is found in the coal measures, and is struck in a dark sandstone. Ten wells are located on Goose Run.

THE SALINEVILLE DISTRICT.

These mines are in Columbiana county, are all drift openings, and are opened in No. 6 and 7. No. 6 is from three to seven feet high, has a fine roof, and the workings are high and dry. No. 7, a three-feet seam, is higher up in the measures, being separated from No. 6 by strata ranging from thirty-three to seventy feet in thickness. The roof is also good, and the working places dry. These mines, taken in their aggregate and in their parts, are among the worst ventilated in the State. Powder is used in every working place to get down the coal, and the miners fire at all hours of the day. The powder smoke hangs in blinding and suffocating volumes. Until recently the forces of nature alone created the air currents, and they generally came and went without control, as no proper air-courses nor air-doors and stoppings were provided to direct forward and distribute the slow-moving stream. Some of the mines are yet without sufficient artificial means of forcing forward air, and also without the necessary air-ways. In all of them the current of air is not as strong as the law requires, nor are the air-passages and doors as numerous and as promptly provided as they should be. All the mines are opened on one plan, though some of them are in much better order than others. To have good air double entries—main and butt alike—must be made, and all the stoppings closed up as fast as new air-channels are cut through at the heads of the entries and rooms. I have had several complaints of bad air in the mines of this region, all of them too well founded, and, unless improvement is made in the ventilation, will be obliged to apply to court to enjoin or restrain their working with more than ten men at once until they are made to comply with the requirements of the law. Much suffering and cause of complaint could be avoided by prohibiting the miners from blasting more than once per day—at four o'clock in the afternoon, as is done in many other districts; but even were no blasting done at all, the ventilation is too feeble, and the air channels too few and far between for the sanitary requirements of the mine.

WASHINGTONVILLE AND NEW LISBON DISTRICTS.

Around the villages of Washingtonville and Leetonia, along the line of the Niles and New Lisbon Railroad, the mines are opened on two thin but valuable beds of coal, Nos. 4 and 5. They are about forty feet apart. The upper coal is the more highly prized, although the thinner bed. Only in two cases has the lower coal been tapped—at the shafts of the Salem Coal and Iron Company, and the Grafton Coal and Iron Company—in both of which shafts the two seams are raised together. The upper coal is only twenty-eight inches thick, but it is all pure, and is all sent out, slack and run of mine together, and converted into coke at the pit's mouth. The entries of the mines are made of sufficient height by blasting down the roof shale to admit of handling mules, but the rooms are only the height of the seam. In these low chambers several hundred men earn their daily bread. The rooms are carried forward fifty yards, and are then finished up, new openings being made in advance galleries. The mines of the Cherry Valley Iron Company, three in number, one slope and two drifts, were in good condition, except in a few cases at the entry-faces, where the air-ways had been neglected. Proper means of exit were found, and at the slope-mouth an approved safety-spring was attached to prevent the cars from running down the slope in case of accident. This is the only spring I have seen in the State which could be applied to advantage, and as filling the requirements of the law, and its application ought to become general.

The mines of the Grafton Iron Company were running only six or eight men, at the date of visit, on the lower coal. They were engaged cutting an entry forward to the boundary of an entry in the upper coal, which had dipped and was submerged by a recent inflow of water.

The mines of New Lisbon were idle, and were not visited. They are drift openings. The coal is No. 6, and is of varying height, usually about four feet.

The miners of Washingtonville are among the most intelligent and progressive of their class in the United States. They have built a mining institute, in which they meet regularly for mutual improvement. In the evenings the institute is used for a night-school, at which the boys and young men of the mines attend. On Saturdays the older people meet to discuss questions of government and matters of interest bearing on the amelioration of the werking men. On Sundays the institute is converted into a church, the preacher, in most cases, being one of the miners themselves. A number of the miner-boys have used the savings of previous earnings to educate themselves, and are now about to enter the learned professions. During the vacations of school these lads returned to the mines and worked their way up by their own energy and perseverance and frugal habits. The future of such young men is already known. They will yet command the attention of states and nations. Of just such material are the great men of every age and nation.

In the construction and management of this institute the miners have had the countenance and assistance of the company and its officers. The company gave the lot on which the building stands, and the superintendent of the mines gave sixty dollars and advanced the money to erect the building, the miners paying him back with interest on the money borrowed.

If other coal companies would take equal interest in the moral improvement of miners, there would soon grow up a healthier sentiment between the laborer and his employer, and strikes and lockouts would be fewer. And if, after the hard and exhausting toils of the day, the men of the mines had some place to meet, where books and newspapers could be had, there would soon be fewer saloons in the mining villages of the State.

The coal of the mines of Washingtonville and Leetonia, although only two feet four inches high, costs, in some cases, only sixty-eight cents a ton for digging and loading, while the ten-feet coal of Perry county costs sixty cents a ton. At Leetonia all the coal is sent out as it comes from the workmen's picks, and no powder is used to get it down. In the thick seam of Straitsville and Shawnee two layers of slate are interstratified with the bed, to clean which it costs the miner much time and trouble, and in addition about one-fifth of the coal which the miner hews at these thick seams is made into slack and nut coal, for which nothing is paid. In coal-mining the quality of the mineral is of more importance than the height of seam. The miner's ability to produce a given quantity of tons per day is not always in proportion to the height of seam.

THE MAHONING VALLEY.

This region, the most extensively developed in the State, was the first inspected after my appointment to office, in April of 1874. The law gave stated times for certain of its provisions to be applied. I went from one mine to another, examining all their underground workings, machinery, etc., and notified every company by printed circular of the requirements of the law, and that the provisions of the act must be complied with. These circulars were also sent to all other operators in the different regions of the State, as far as known at the time. After having traversed the various mining districts and made examinations of the great majority of the mines, many of them two and three times, I re-commenced work in the Mahoning Valley, and found that while there was generally more care and attention given to the ventilation, and in most cases safety-catches and covers for cages had been provided, the speaking-tubes had been neglected. One of the mines, the Sodom slope, in Trumbull county, had had an inch speaking-tube applied, but as the slope was nearly five hundred feet in length, the tube failed to convey sound so great a distance, and was withdrawn. On being notified of these facts, I wrote to one of the Pennsylvania inspectors regarding the size of tubes in use in the anthracite regions of that State, who informed me that it required in practice a two inch or two and a fourth inch tube to convey sound five hundred feet so that conversation might be held at both ends of the pipe. I notified a number of the companies of the size of tubes required, and urged them to apply them as the law directed. Each superintendent said he was waiting on some one else leading off, and so none of the slopes of the valley provided them.

Finding defective ventilation prevailing in the advance places of a number of mines, and that the law would be disregarded in other particulars unless the penalty attached for violating its provisions were visited, I asked the opinion of the Attorney-General in regard to employing an attorney to prosecute proceedings in injunction, and also as to my duty in case of willful and persistent neglect on the part of a coal company to obey the law. The following is the answer of the Attorney-General:

"COLUMBUS, March 23, 1875.

"HON. ANDREW ROY, *Mine Inspector, Columbus, Ohio:*

"SIR: In answer to yours of the 21st instant, I have to say—

"1. If it becomes necessary in the discharge of his duty to have an attorney to prosecute proceedings in injunction under the 14th section of the act regulating mines and mining (Laws, 1874, page 24), the mine inspector may employ and out of his contingent fund pay such attorney.

"2. Said act, by implication at least, makes it the duty of the mine inspector to see that the provisions of this act are obeyed. If to compel obedience to the requirements of sections 9 and 10 (or of any other) it is necessary to resort to the remedy by injunction, he, in my opinion, should not hesitate to do so.

"Very respectfully,

"JOHN LITTLE, *Attorney-General.*"

During the spring and summer I repeatedly urged upon the mine superintendents of this valley that the tubes must be put in, but finding no disposition manifested to comply with the law, I employed Messrs. Taylor and Jones, attorneys-at-law, Warren, Trumbull county, to prosecute the Niles Coal Company, under section 9, and the Church Hill Coal Company, under sections 9 and 10, the former company for having defective ventilation, and the latter for defective ventilation and neglect or refusal to apply a speaking-tube in the slope. At the same time I employed Messrs. Foran and Hassack, of Cleveland, to prosecute the Mahoning Coal Company, under sections 8, 9, and 10, the mine having but one proper means of egress, having also defective ventilation, and being without a speaking-tube. In this latter case the court, in accordance with the petition, granted a temporary injunction, but it was at once dissolved by mutual consent, and the case set for trial in November following. It has not yet been reached. The cases against the Niles Coal Company and the Church Hill Coal Company have also not yet been reached. I have recently received a communication from the Niles Coal Company, stating that the ventilation had been improved, and requesting the discontinuance of legal proceedings. I shall make an examination of the mine before the case comes up in court, and if the law is now being complied with, will withdraw the suit.

The excuse made by the Church Hill Coal Company for failure to provide the speaking-tube is that this part of the law is useless, and consequently oppressive. The superintendent thinks that tubes are proper and necessary in shafts, where the human voice can not be understood, but in slopes, through which the miners can travel at will, there is no necessity for having them. Their necessity is greater in shafts than in slopes, but their necessity in slopes is none the less on that account. These slopes, and in particular the slope of the Church Hill Coal Company, is a dangerous passage-way from the bottom to the top, and no miner ever makes the journey through it withont experiencing some degree of fear. The miner from below has occasion to call on top for props to protect his working place. Some one must ascend for them, and ascend behind the loaded train. There is no room for travel on either side of the slope, and as the empty train goes plunging past, the traveler must seek refuge by climbing over the pitments and discharge-pipes of the pump. A man may also get seriously hurt in the mine. In those cases of danger moments are precious; communication can be made in a moment through the speaking-tube; without it some one must climb five hundred feet of a slope on a grade of forty degrees. The chain may break, or the empty train may be pushed over the brow of the slope by accident. The alarm, under such circumstances, can be sent below with telegraphic speed by the "call" on the tube. Without the tube the lives of the people at the bottom are imperiled, and not a few fatal accidents have been caused by this means. In some slopes the occurrence of fire in the wooden structures near the mouth of the slope might imperil the safety of the whole underground population, and a fire occurring in the slope might do the same thing. Indeed, the accident at the Atwater slope, which occurred in July, 1872, by which ten out of twenty-one miners were lost, was caused by the slope timbers taking fire. A boy on top, observing the fire, ran down through the burning timbers to alarm the miners, and perished on the way out.

Mr. T. M. Williams, inspector of mines for the Wilkesbarre (Pennsylvania) district, to whom I wrote for information in regard to the size of tube in use in Pennsylvania, replied as follows:

For a length of	200	feet, we use	1½-inch	diameter.
"	300	"	1¾-inch	"
"	400	"	2-inch	"
"	500	"	2¼-inch	"
"	600	"	2½-inch	"

Our operators, adds Mr. Williams, are using galvanized gas-pipe—galvanized outside as well as inside. Some use nothing but common gas-pipe, and as a matter of course such pipes require to be of larger diameter because of the roughness of surface.

The Kyle shaft of Mahoning county, on my first visit to the mine last year, was without covers for the cages or safety-gates over the entrance of the shaft. The mine made fire-damp, and every man was his own fire-viewer. On my second visit I found a great change for the better; not only were the cages covered and safety-gates applied, but the ventilation had been greatly improved. All the doors for guarding and directing the currents of air in the mine had been so hung and adjusted that they shut of their own accord and can not stand open, and they were unusually well constructed and hung. A large and powerful ventilating furnace had been erected, moving 20,000 cubic feet of air per minute, and an experienced fire-viewer appointed, who examines the mine every morning before any of the miners are allowed to enter.

The following regulations I found in the engine-house of this mine, and commend them, or something similar, to the notice of other mine superintendents in the State:

RULES AND REGULATIONS OF KYLE SHAFT.

1. No man shall be allowed to descend who is intoxicated.
2. No more than ten men shall be allowed to ascend or descend on any one cage.
3. No man or men shall be allowed to descend with the mules, except the man in charge.
4. Drivers and mules shall first descend the shaft in the morning, in order to prepare for work.
5. The hitcher-on shall have full control of the shaft during working hours.
6. Not less than three men shall be allowed to ascend during working hours, except entry-men, or in case of a sickness dispatch from top.
7. No person shall interfere with the signal wire while the holder-on is on duty.
8. Any person who shall commit a nuisance in the air-ways or gang-ways, or destroy, brattish, or leave doors open, shall be reported to the State Mine Inspector.
9. These rules and regulations must be strictly observed.

D. B. STAMBAUGH, *Superintendent.*
JONATHAN OATEY, *Pit Boss.*

In a number of mines of this region many advance places are badly aired, because they are pushed ahead in the fast, and a circulation is only got up after rooms are broken off the entry and communication made from one to another by cross-cuts in the pillars. From six to twelve men are thus working ahead of the air in a stagnant atmosphere. In the first few hours of work, the working places are generally clear, and fit for the abode of the miners, but the atmosphere is hourly thickening with the smoke from the workmen's lamps and the exhalations from their lungs and bodies; and in the afternoon it is frequently the case that the combustion of the lights can only be maintained by hanging the lamps to a post or to the pillar side and turning them downwards. This condition of the air is rarer now than formerly, and must disappear altogether. There is no excuse whatever to have any part of a mine without an abundant supply of air, except the excuse of bad management, ignorance, or avariciousness. Safety-catches, safety-gates, and covers for the cages have also been generally applied. The safety-catch, however, should be frequently tested, say every four or six months, for its springs will lose their force by constant use and become worthless. I have been informed of a rope breaking since the law went into force where the safety-catch failed to hold the cage, although when first applied and tested it proved perfectly satisfactory.

The early part of the present year witnessed another of those long and disastrous strikes which arise over wages disputes. The mines were idle for four months, and in one instance the buildings of a colliery were destroyed by fire. The guilty parties were not discovered. Such lawlessness is discountenanced and condemned by the great mass of the miners, but it is their duty to ferret out and have the guilty parties punished.

MASSILLON REGION.

The Massillon region embraces all the mines opened on the lower coal No. 1. These mines are located in Stark county, Summit county, Wayne county, and Medina county. More powder is used in this region than any where else in the State, or perhaps in the world, in recovering the coal, at least one and one-fourth pounds being burned for every ton of coal mined. The coal is nearly all blasted out of the solid wall face. The undermining part of the seam is very hard, and the coal is better adapted than most seams for blasting out of the solid. Few of the miners blast during the working hours of the day, the prevailing rule of the region being to fire at 4 o'clock in the afternoon. In a mine working a force of one hundred and fifty men, when the discharges take place, thirty or forty kegs of powder are burned, the earth shakes with the force of the explosion, and the miners retreat in haste to the surface. For several hours after these subterranean explosions, no human being could enter the mine and live.

Most of the mines of this region are worked on the double entry system, and the advance places, the entries, and inmost rooms (which in some other districts are nearly always in a defective state for want of air) are as well ventilated as any part of the workings. All the new mines are now opened on the plan of driving the entries double, and the superintendents one and all say that no additional cost, but that, when eve
thing is considered, a saving is had over the plan of single entry
narrow air-courses, and no air-courses at all so long as a light can
maintained.

The Wadsworth slope of Humphrey and Colman has been vi
times within the past fifteen months, and has been twice su

is approaching the workings of an abandoned mine filled with water. Between twenty and thirty acres of coal were excavated in this old mine, when, it having been worked up to the boundary of the property, the miners withdrew their tools and the slope filled with water. This occurred before the inspection law went into force. Under the first act regulating mines and mining, passed in 1872, the operators of mines were required to keep a map of the workings, but the law was generally disregarded, and the exact locations of these old workings are not known. I have a map of the old mine, furnished by Mr. Colman, the superintendent of the Humphrey and Colman slope, which he prepared from a survey made by himself, and which is believed to be nearly accurate, as the surveying was done not long before the abandonment of the mine. There is yet several months' work to be done before the old and the new workings are holed through, but the miners are in daily dread of holing through into the old workings, and of being drowned by the inflow of water. The company have promised to keep two holes in advance of the workings, so as to tap the water and thus avoid flooding the mine.

This case suggests two amendments to the mining law, namely, that every mine-owner should be required to notify the Inspector at least four months in advance of his purpose to attack the inmost pillars with the object of finishing up the mine, and it should be the duty of the Inspector to see that an accurate map or plan of the mine is then made, covering all the excavations, and filed in his office; and further, that at the suggestion or order of the Inspector two holes should be kept at least twenty feet in advance of the workings when a mine is approaching an abandoned mine supposed to be filled with water or charged with mephitic or inflammable gases.

On my first visit to this mine I found very poor air prevailing, and a spirit of general discontent and fault-finding existing among the miners, a result invariably found where bad air existed in a mine. I urged the boss to improve the ventilation, and wrote to the owners of the mine, earnestly calling their attention to its condition. They thought the air was good, and that the complaints arose from an inherent spirit of fault-finding among a certain class of their miners. The ventilation has now been greatly improved, and if it is properly attended to will remove all cause of complaint, for, as already stated, the miners, even the most unreasonable among them, never complain of bad air when their working places are in a fit state for men to work; and this mine is no exception to the general rule. As the ventilation has been made better the miners have become more reasonable and are better satisfied. There is less grumbling and fault-finding with the mine and its management than formerly, and if the air is properly provided at all times, there will be none of it.

The Maple Grove mine, situate at North Lawrence, is another mine where a spirit of discontent and fault-finding prevails among the miners. This mine works a large force of men, and by reason of numberless horsebacks and a fragile roof the ventilation is not easily managed. Nor are the means applied for getting fresher air of first-class order. Canvas clothes, which soon become filled with holes, and spill air that is needed to supply the miners at the working faces, are used in entries instead of doors. Arrangements are almost always in progress to get purer air, yet the working faces of the mines continue to be in a defective state, and the miners grumble and complain. It is proper to state, however, that by the occurrence of one boiler explosion and two fires at the mine since the law went into operation, which laid the workings idle and disarranged the air-courses, the means of promptly applying a thorough ventilation have been wanting. These facts the miners take no note of, and it must be added that, with every disadvantage, the air might well have been better than it has been.

The wooden structures surrounding this mine have been twice burned down during the year. The first time the fire occurred it was an act of lawlessness which can admit of no excuse, and for which the severest punishment should be meted out to the guilty parties. This fire took place during the prevalence of a strike in the spring of the year. Four masked men caught and bound the night engineer of the mine, and soon afterward the engine-house was in flames.

The second fire occurred in September, and was, in my judgment, the result of an accident, though the pit boss was disposed to attribute it to incendiarism. This fire broke out in the upcast shaft, at the bottom of which the ventilating furnace stood. The fire was first seen in the wooden structure covering the top of the shaft, and could have been (as it doubtless was) communicated to this building from the furnace at the bottom of the pit. Many a fire occurs from this cause, and too great care and attention can not be given in locating a furnace in a mine.

The superintendent of the Middlebury shaft, in Summit county, as soon as the law went into force requiring two separate outlets to all mines, by which distinct means of ingress and egress shall
available for the persons employed in the mine, cut a
from the bottom of the mine to the surface, to form a
traveling-way for the miners to pass through at p
already an air-shaft sunk, but the officers of thi
construction on the law, and made the egress of

in case of accident, beyond a peradventure. This mine is also one of the best ventilated in the region, and has always maintained this reputation.

A large number of the mines, ventilated by furnace power, while having two openings—the main opening and an air-shaft—have not means, immediately available at least, for the speedy withdrawal of the men in case of fire, or the closing of the main opening from any other cause. The furnace is placed directly at the bottom of the air-shaft, and the heat, smoke, and gases evolved from the fire would forbid any attempt at exit until after the fire was put out and the side of the shaft cooled down. A fire occurring at the main opening (which is always the downcast, where a furnace is placed at the bottom of the air-shaft) would, as soon as sufficient heat were communicated to the burning timbers over and in the shaft, to render the air specifically lighter than the air in the furnace shaft, reverse the ventilating current, and the smoke and gases from the furnace would spread through the mine and endanger the lives of the whole underground population. Such a condition may not occur in the course of a century, but it is not an improbable case. A ventilating exhaust-fan, placed on top of the up-cast shaft, would remove this danger better than even a third opening to a mine.

The ventilating furnace is the favorite power for causing a movement of air in the mines of this State. A number of mines rely upon the exhaust steam from the steam-pump at the bottom of the up-cast shaft for ventilation—always too feeble a power—and one mine has an exhaust-fan in use. For shallow mines, and mines which give off no fire-damp, the exhaust-fan is to be preferred to any other ventilating power. It costs less than a furnace, and its action is constant; besides, and most important of all, the danger of fire in the wooden structures of the shaft is avoided. I would earnestly recommend to all mine-owners opening new mines to apply a Guibal exhaust-fan instead of a furnace. Since the fatal mining catastrophe of the Avondale shaft, in the anthracite region of Pennsylvania, the exhaust-fan has come into general favor, and is every where preferred to a furnace.

Two new shafts have been sunk during the year in this district. They are both provided with all the appliances required by the mining law, and double entries have been started off in opening up the workings. The ventilation in each is provided by the exhaust steam from the pump at the bottom of the shaft, but when the workings extend, and a greater power is needed, I would urge the proprietors to use the exhaust-fan, as being cheaper, more serviceable, and freer from danger. These fans can be placed on top of the up-cast shaft, and be under the control of the hoisting engineer of the mine. By applying a fan, the air-shaft, in which it is the custom to place the ventilating furnace, can be made available at all times for the withdrawal of the miners in case of accident to the main opening, and a ladder or stairway may be put in the air-shaft, reaching from top to bottom, on which miners can pass up and down at will.

A new slope, now in progress of sinking, is being supplied with a brattice, which divides the opening into two permanent compartments—one a hoisting-way, the other a gang-way for the miners. By this arrangement the workmen can pass up and down the slope at pleasure without coming in contact with the cars. This is a much needed improvement. The slope has heretofore been more dangerous to life and limb than the shaft, by cars running over people in passing to and fro. It is a pleasure to record these improvements. The business of coal mining can be made comparatively safe and healthy, and when the maximum has been reached we will hear less of strikes and other troubles at the mines.

In my first annual report I called attention to several important defects in the mining law, which I again take occasion to notice.

The section forbidding boys under twelve years of age (and under sixteen, unless they can read and write) provides no penalty for violating its provisions. When the law was first enacted this section was very generally respected, but since it is known that it is of no binding force, many of these boys have been taken back to the mines, in some cases the mine bosses setting the example by returning their own boys. Night-schools sprang up in a number of districts, and now most of them have gone down.

There is no penalty for failure to report accidents, serious and fatal, and very few serious accidents are ever sent me by the officers of the mine. Those of a fatal nature are not promptly reported. One case where a man lost his life in violation of the law was reported, but no inquest was held.

Only in one case have I received monthly reports of the amount of air in circulation in mines which evolve fire-damp. All such mines, however, appear to be under proper discipline, no miner being allowed to descend until the morning fire-viewer returns and reports the condition of the mine. The ventilation in all such mines has been measured by myself, and found to exceed the requirements of the law. There were but two cases during the year of accidents by fire-damp explosions, and they were both slight. It would be well to require all bosses to return monthly reports of the amount of air in circulation, whether fire-damp be given off by the mine or not. If the air is provided as the law requires, there will be little suffering in a mine from foul air.

The only penalty under the law for neglect or refusal on the part of a mine superintendent or mine owner to comply with its requirements is by a competent court enjoining or restraining the working of the mine with more than ten men at once until such mine is made to conform to the law. In most cases this action brings punishment to innocent miners by throwing them out of employment, and in times like the present men will work in any place, however dangerous, for the sake of steady employment. Where the law is violated by neglect or refusal to apply adequate ventilation, or in providing safety-gates, safety-catches, etc., the guilty parties should be punished by fine and imprisonment; but in the case of a mine immediately and suddenly dangerous to the whole population, as where but one outlet is provided, the sooner the working force is reduced to ten men the better, this number being required to drive the galleries, or work from below upward, when speed is necessary to complete a double passage-way to a mine.

One great crying want of our miners is some educational establishment wherein they might acquire a knowledge of chemistry and physics, so as to enable them to understand those natural laws with which they are hourly called to deal. The responsible managers of mines (the underground bosses) are generally selected from among the more intelligent and thoughtful of the working miners, and the great majority of them can read and write, but not one in fifty know how to use a compass in a mine, or how to plat the underground workings after they have been surveyed, nor are they able to measure the amount of air in circulation, or have ever seen an anemometer, and they virtually know nothing of the laws which govern the movement of air in mines. Every nation of Europe provides by law for the education of its master miners, and in no country but the United States is a mining superintendent allowed to assume charge of the underground departments of mines before first passing a satisfactory examination before a board of examiners, and receiving a certificate of competency.

I would earnestly recommend that provision be made by law for a mining department in the Agricultural and Mechanical College, so that the young men of the mines, equally with the farmer and mechanic, may have an opportunity of a scientific training in their art. Many young men would gladly avail themselves of such opportunity, did it exist. Coal is one of our most important elements of industry, and will continue to grow in importance for centuries to come. With better trained engineers, there would be increased saving, not alone in human life, but also in the cost of recovering the mineral resources of the earth. Already millions of tons of coal have been lost beyond the possible hope of recovery, by bad management, and thousands of dollars are annually spent to no purpose in mines, in efforts to save from threatened ruin some portions which have been made too weak, or have been otherwise unskillfully worked in laying out the mine. The teachings of all other mining states in which there have been legislative enactments for the protection of miners, and schools established for the education of master miners, is a lesson to us.

In my last report I alluded to the requirements of the law in regard to mine maps. The law requires that a report of the extended workings of a mine shall be forwarded to the Inspector every four months, to be added to the map previously provided by the company or mining operator. There can not be any real necessity for a report of extended workings oftener than once in six or even in twelve months, and if there were, it would take all the time of two expert mining engineers extending maps. Work of this kind the Inspector can not well do, for want of time. Indeed, the work alone of visiting and inspecting all the coal mines of the State, which ought to be done at least once a year (many of them ought to be examined two and three times), can not be done by one officer, if he were constantly employed in such duty alone. The work of extending maps, answering correspondence, and doing other office work, could be equally well done by a clerk in the office, which would give the Inspector more time for work at the mines.

The Inspector is sometimes obliged to apply to court to have the requirements of the law enforced and obeyed. In doing so, he must engage an attorney, and the expense thus incurred could be saved by requiring the prosecuting attorney of the county in which the mine complained against is situate to prosecute all such cases.

At the last session of the Legislature, an appropriation of $250 was made for the purchase of office furniture, and to fix up a place in the office of the Mine Inspector for the preservation of a State cabinet of the coal flora. During the past year a number of valuable coal plants were collected and sent up here from the mines, but there being no proper place to keep them, I had them sent up to the Agricultural College, and they now form part of the collection there. The money appropriated for the purpose of fixing a place for them in this office has, therefore, not been expended.

GENERAL REMARKS ON MINING AND VENTILATION.

Laying Out the Workings.—A number of circumstances and conditions require to be considered in adopting a system of working a coal mi whether shaft, slope, or drift opening, such as the texture of the co to hardness and softness, its power of resistance, the nature of the floor, the character and thickness of the superincumbent strata, the situation of water, towns, or valuable buildings on the surface, and the best method of producing the maximum quantity of coal consistent with the safety of the mine and miners, and a minimum outlay of money. There are four general systems of laying out underground workings:

1. By pillars and rooms; leaving pillars of just sufficient strength to support the superincumbent strata in mining forward. This is the oldest and rudest system of coal mining, and is now only practiced in drift-mining regions, and in shafts having a very light cover, and where the coal, floor, and roof are hard and strong, admitting of very wide rooms and very small pillars. This plan is sometimes called stump working.

2. By pillars and rooms; leaving pillars of extra size and strength in working forward, with the object of attacking and removing the pillars by working backward towards the bottom of the pit, after the rooms have all been advanced to the limits of the mine. In working home, about one-third of the coal is generally lost, partly by deterioration (the long-standing pillar coal never yielding as well as coal cut from the new, fresh face), but generally by crushes, which overrun and destroy part of the pillars as the whole seam is being cut away, or by creeps—the coal sinking into the bottom and closing up the mine.

3. By panels or squares; withdrawing the pillars of each panel after the rooms are worked forward, and allowing the incumbent strata to crush and fall in the exhausted square, while the general excavations of the mine are progressing forward. In mountainous regions, where drift mining is practiced, and the waters of the mine discharge themselves, this system is capable of general application. It is often practiced with success in deep shafts whose lower strata are comparatively free from water. Its advantages are a greater acreage of coal than in working to the boundary of the mine, and then drawing pillars.

4. By long-wall; removing all the coal as the workings progress forward, and allowing the whole incumbent strata to fall down behind and over the heads of the miners. This is the best system of all, but is only applicable to seams of moderate height and with accompanying conditions.

In the first and oldest system of mining, where all the conditions are favorable, three-fourths of the coal is sometimes mined out. A practice in British mining is to work the rooms and cross-cuts of the same width, and to leave the pillars in square blocks of the width of the rooms. To add strength to the pillars, they are sometimes left diagonally, like the blocks of a checker-board. When the workings are advanced forward to the boundary of the mine the workmen withdraw their tools, no attempt being made for the recovery of any part of the coal left standing. In mines where the conditions are less favorable, the pillars are left of greater thickness and strength in working forward, and after all the rooms are worked out they are pared down or winged, until a crush comes on and overruns the whole mine. This system has now very generally gone out of practice, and prevails only in regions where coal is accessible by drift openings, and where coal lands are abundant and cheap.

The second system, of working with pillars of extra strength and size, with the object of attacking and removing them after the rooms are all advanced to the boundary of the field, is also fast giving way before more approved methods. In working over large areas, where the pillars have to stand for a series of years, it frequently happens, particularly with coal of a soft and free nature, or where the floor is soft and yielding, that some part of the mine gives way, producing a crush or creep. Or, if the pillars stand firm till they are attacked in working home, part of the mine, during their removal, is generally overrun to a greater or less extent. Besides, long-standing pillars never produce as good coal as those of recent construction. Under the most favorable circumstances there is a great waste in mining in the second as well as the first system.

The system of working by panels or squares was devised about the year 1830, by John Buddle, of Wallsend, England, to whom the British nation is indebted for a number of valuable mining improvements. Instead of carrying forward the workings to the boundary of the mine before attacking the pillars, as practiced in the ordinary method, Mr. Buddle laid out the workings in this new system in quadrangular panels, each panel covering ten or twelve acres of ground and including sixteen rooms, and leaving on all sides of the square a solid wall or pillar of coal of varying thickness, according to the depth and nature of the overlying rocks, and the powers of resistance of the coal and floor of the mine. Air-ways and hauling roads were cut through the panel walls at proper intervals, and the rooms started off from the inner parallel gallery were advanced on the face or the rise of the coal till they reached the extremity of the square, when the pillars were attacked and withdrawn, and the superincumbent strata allowed to close in.

The panel system is modified in different mining regions in accordance with varying conditions. Where the mines are level-free and the cover of the coal is light, the rooms may be made larger and the pillars panel walls smaller, and where there is no discharge of inflammabl if a vigorous ventilation prevails, there may be no occasion to make cross-cuts or thirlings for air, every seventy or eighty feet apart. In shallow shaft mines, however, where a break in the rocks of an exhausted panel might cause such an inflow of surface water as to overpower the capacity of the pumps, prudence would suggest advancing to the boundary of the field before the attack was made on the pillars.

As the sole object in leaving pillars in every system of pillar-working a mine, is to prevent a crush or creep of the workings, these supports should invariably be made of extra strength and thickness; not with the view alone of supporting the mine as the workings progress forward, but to prevent the possibility of a crush or creep extending over the pillars, after part of the mine becomes weakened by their partial withdrawal. While the nature of the coal, and of the roof and floor of the mine, vary greatly in different coal regions, requiring larger or smaller pillars, according to the accompanying conditions, a mistake can scarcely be made on the side of amplitude in the mine supports. On the other hand, crushed and lost coal, dilapidated roads, closed air-courses, the contraction of the productive power of the mine, and an everlasting expense for repairs, are the sure accompaniments of weak pillars in the later stages of mining. In deep mines, to reach the coal of which an enormous outlay in sinking is required, the precaution of leaving strong pillar supports is now seldom, perhaps never, neglected. In the Monkwearmouth pit, in England, upwards of eighteen hundred feet in perpendicular depth, four-fifths of the coal is left in pillars in the first working, but nine-tenths of the whole is sought to be recovered in working backward.

No rule can, however, be laid down as to the proper size of pillars and the width of rooms in any system of mining coal by pillar workings, as the conditions and circumstances of the various districts are so different. Even in the same district, and in the same seam of coal, these conditions vary greatly. In one region the coal is soft and friable, and disposed to crumble and fly off at the pillars, as soon as they become exposed to any crushing weight; in another region, the coal is hard and compact, and the pillars of the mine are capable of powerful resistance. In some mines the roof is soft and brittle, invariably forbidding wide workings; in others, the roof and coal are hard and strong, but the bottom is soft and yielding, and the pillars, if left too weak, sooner or later sink into the floor, producing a creep which overruns the mine. The deeper the mine is sunk from the surface, or the thicker the cover over the coal, the greater is the crushing weight to which the pillars are exposed. Leaving large pillars in a mine entails additional expense in advancing the workings, because the narrow work of entry driving must in all cases be paid extra; hence there is a temptation to make the pillars too small, for the sake of immediate returns.

Mr. Dunn, in his "Working and Winning of Collieries," gives the following general table for increase in pillars, in proportion to the increasing thickness of overlying strata. In the table the rooms are supposed to be five yards wide, and the cross-cuts two yards wide:

Fathoms.	Size of pillars in yards.	Proportion in pillars.	Fathoms.	Size of pillars in yards.	Proportion in pillars.
20	20 by 5	.41	180	26 by 14	.69
40	20 by 6	.50	200	26 by 16	.71
60	22 by 7	.52	220	28 by 18	.73
80	22 by 8	.57	240	28 by 20	.75
100	22 by 9	.59	260	30 by 21	.77
120	22 by 12	.61	280	30 by 22½	.78
140	26 by 15	.63	300	30 by 24	.79
160	28 by 16	.66	In Wearmouth.	40 by 29	.80

Coal seams are generally divided and intersected at short, regular intervals by partings or cutters, called face and butt slips, which cross each other at right angles like latitude and longitude lines. In working by pillars and rooms, if the seam of coal to be won lies in the ground in a comparatively flat or level position, and the conditions of mining will admit it, the main galleries are driven forward along the face-slips of the coal, and a series of galleries, each from three hundred to six hundred feet apart, according to the varying circumstances and conditions of different mining regions, are struck off from both sides of the main galleries, and driven along the line of direction of the butts, or end-slips of the coal. The rooms are struck off from the butt entries, and are advanced in parallel lines along the face of the coal, a pillar of coal being left between each room for the support of the superincumbent rocks. Where the coal bed dips in the direction of the face of the coal, the main entry is worked to follow a level course, without regard to other conditions, but an aim is always made to drive the side entries on the butts, and to work the rooms on the face, as the coal, in nearly all cases, is easier mined on the face.

In general cases the entries of a mine, side and butt alike, are cut very narrow, generally about eight feet wide, to give security to the roof and strength to the mine; but there is very great diversity in different regions as to the width of the rooms and the thickness and size of the pillars. Rooms vary from twelve to forty feet in width, and pillars from six to forty, and even sixty feet in width, according to the depth of the superincumbent rocks, the nature of the roof, the power of resistance of the pillars, and the character of the coal floor.

In the long-wall system of mining, all the coal is cut away as the workings extend progressively forward; but this plan is limited to circumstances. Wherever the conditicns exist favoring this method of mining, it should be preferred to all otners. The late Mathias Dunn, British Inspector of Mines, gives the following conditions under which the long-wall system may be adopted:

"1. If the coal be thin, hard, and capable of bearing pressure, or the top and bottom be soft, requiring a considerable quantity of cutting for the necessary tram height.

"2. If band or rubbish be mixed with the coal, requiring to be stowed underground, so as to furnish a cheap and plentiful supply of *debris* for filling.

"3. If the distance from the shaft to the boundary line be limited.

"4. If the roof be free from water, and the workings clear of buildings, rivers, etc.

"5. If the roof contain ironstone, to be worked with the coal, thereby producing much refuse, or if it be so soft and brittle that it will not stand for ordinary pressure.

"Under these and many other circumstances the long-wall system may be recommended. There may, however, be objections, rendering such workings impracticable, viz:

"1. If the workings produce a considerable quantity of inflammable gas, either from the seam itself or from some superior seam.

"2. If the roof contains water, the letting down of which would spoil the tram-ways or overpower the engine and pumps.

"3. If the coal be so near the surface that the long-wall workings would have the effect of damaging buildings.

"4. If the cuttings of the roof or floor for height are so soft or friable that they would not be sufficient to support the roads, in which case the expense of setting additional props or obtaining other material may exceed the value of the coal, or its cost by another system.

"5. If the seam be deep, and from its thinness suitable for long-wall, yet the small quantity ordinarily producible from one establishment may render its workings unprofitable; or, in other words, the maintenance of expensive roads or the number of pits required may not be repaid by the working thereof."

The system of long-wall working is very largely followed in Scotland, fully fifty-five per cent. of all the coal raised in that country being got on the long-wall method. In Shropshire, Derbyshire, and Leicestershire, and several other mining regions of England, it is the favorite manner of mining. It is also adopted in many of the mines of South Wales, and is extensively practiced in Belgium and Saxony, on the continent of Europe.

To obtain the full benefit of working out coal by the long-wall system, the line of direction of the wall-faces should be at right angles with the face-slips of the coal seam. Under ordinary circumstances, the coal never works as well when the walls are advanced on any other course. In deep mines, however, when the bed of coal is very tender, the heavy, overlying pressure breaks up the coal too fine in working forward on the face, and better results are obtained by advancing the walls on the butts.

Seams of coal which have bands of slate running through the body of the coal, or have a "falling" of shale, which comes down as the coal is mined out, are best adapted for long-wall, as this refuse material alike serves for stowing away in the gob-waste and for building the pack-walls for the maintenance of the roads.

In laying out the workings of a mine on the long-wall method, a strong, square pillar of coal is left around the bottom of the pit, to preserve the shaft from becoming involved in the break of the stata which follows the removal of the coal. Double entries are then advanced forward on both sides of the shaft, and on the butts of the coal, if the conditions will admit of it; if not, on a water-level line. The lower entry serves for a permanent air-way; the walls are struck off from the upper one, and are advanced upon the face of the coal, one wall following the other in echelon, and having each a loose end. The width of the walls are various, to suit varying conditions, but they generally range from twelve to forty yards. In some mines there is a wall-face of three or four hundred yards extended in a straight line; and sometimes a line of face is formed like the arc of a circle. The general plan, however, is to advance the walls in echelon.

The roads of the mine, which are made from six to eight feet wide, are maintained by building pack-walls on each side of tne road. The material for this purpose is got out of the roof or floor. The refuse coal and *debris* of the seam, such as clay partings and dirt bands, are thrown back in the gob-waste, to receive and resist the crushed and falling roof strata. In some cases, where suitable material does not exist in the mine for building the pack-walls, it is brought down from the surface, but this adds greatly to the expense of getting the coal. The thinner the seam of coal is, and the more refuse it makes, speaking in general terms, the better it is adapted to the long-wall system of mining.

Care and skill require to be exercised in building the pack-walls of the hauling roads. If these walls are not well built, or if they are constructed of material of a soft and friable character, the weight of the overlying rocks, during the subsidence of the strata, will crush and squeeze them, and entail a great expense in keeping up roads. Unless the mine is also kept running constantly and regularly, the roads are very difficult to keep in repair, and the wall-faces become choked up by the falling of the roof.

In excavating the coal by the long-wall system, the miners make it a point to have a day's coal undermined before leaving work in the evening. During the night, the undercut wall-faces, exposed to the weight of the roof, loosens the coal, so that it often falls down before the workmen return next morning. The new made fresh roof stands firm, supported by a double row of props at the point of the last break, until a new set of props is placed nearer the face, and the outer set withdrawn, allowing another break of the overhanging strata to close down on the gob-waste.

The advantages of the long-wall system over any method of working by pillar and room, consist in the extraction of the whole of the coal, and in the simplicity of the manner of mining, and means of providing and maintaining ventilation. Where the mines are deep, and the coal is reached only by a great outlay of money in sinking, this system of mining, even if it cost more, ton for ton, than the common method of pillar and room, will save in the end, in the greater yield of coal to the acre.

Where the conditions are neither favorable to the system of long-wall nor to any general plan of pillar and room-working, as where the seam is soft and friable, and lies under a deep and treacherous cover, the coal is sometimes recovered by driving forward the galleries of the mine to the boundary of the field, and working backward towards the bottom of the shaft. This plan entails a long delay, after coal has been reached, before any profits are returned on the mining adventure; but its advantages consist in a thorough control over the ventilation of the mine, in a greatly lessened cost in maintaining roads, and the avoidance of the possibility of a crush or creep of the workings. In working backward, the long-wall system or a suitable plan of pillar and room may be adopted. This system of opening up a mine is to be commended above any other, but its failure to produce immediate returns will always prevent its general application.

In Germany and other states of continental Europe, where the minerals are owned by Government, the main object considered in the development of the property is the greatest possible extraction of the mineral treasures of the earth. In Great Britain, where the owners of coal and other mineral property seldom operate the mines themselves, but lease to companies, care is taken by the owners, in drawing up leases, to prevent any useless waste of coal by bad working; and the mining viewer, employed by the land owner, appears in the same relation as the Government inspector on the Continent. In the United States, however, the minerals and land both are almost always owned by the mining operators; and as mineral property is cheap and abundant, the great object is to mine out the best coals in the cheapest manner possible, without regard to ultimate consequences. As a consequence, we are wasting our valuable mineral treasures in a most shameful manner.

Gases of Coal Mines.—Mines which are shallow, such as drift mines or shafts of less than one hundred feet in depth, seldom, if ever, give off fire-damp in any alarming quantity, it doubtless having escaped long ages ago where the coal beds have been laid bare by the erosions of the land. It is generally met with in greatest abundance in shafts ranging from six hundred to twelve hundred feet in depth. It frequently escapes in the form of blowers, which produce a hissing noise, and which, when ignited, burn like a long blow-pipe. As it exists in a highly compressed state, being pent up by the counterpoising pressure of the atmosphere, any lightening of atmospheric pressure, as indicated by the fall of the barometer, is a sure presage of an unusual flow of gas.

As wherever the fire-damp accumulates to the point of an explosive mixture a naked light can not be used amongst it, several ingenious methods have been devised to light the workings of mines without producing an explosion of fire-damp. In the early ages of mining, when the miner ventured only a few hundred feet into the bowels of the earth, the reflection of the sun's rays, by means of a mirror, was practiced to throw forward light. The steel mill, invented by James Spedding, of Whitehaven, in England, in the year 1775, was used for many years. This machine, which consisted of a small iron frame, upon which two wheels were mounted, to one of which there was attached a piece of flint, threw a succession of sparks of fire during the revolution of the wheels, and yielded a miserable glimmer of light. It required one man to operate the mill to give light to a single workman, and sometimes explosions of the inflammable air occurred from the flying sparks. Since, however, no better means were known of lighting the underground workings in an explosive mixture of fire-damp, this machine was in very general use until the discovery of the safety-lamp, by Sir Humphrey Davy, in the year 1816.

In 1812, in consequence of a dreadful explosion of fire damp which occurred at the Felling colliery, in England, by which ninety-two human beings were scorched and suffocated to death, a society of gentlemen was organized for the purpose of instituting inquiries into the causes of coal mine accidents. The meritorious exertions of this association attracted the attention of Sir Humphrey Davy, and in 1815 he visited the coal mines of the Newcastle field, where he was introduced to John Buddle, the ablest mining superintendent of his day. Mr. Buddle collected various specimens of the fire-damp from the mines, and sent them to Sir Humphrey, in London. After a series of elaborate investigations, Davy made the discovery that flame would not pass through small tubes of wire gauze containing twenty-eight holes for each inch in length, or seven hundred and eighty-four apertures to the square inch. He then inclosed a small oil lamp in a cylinder of wire gauze, and presented it as a gift to the miners of Great Britain. Mr. Buddle and other mining engineers immediately put its security principles to the most searching practical tests. In a letter complimenting Sir Humphrey on the discovery, Mr. Buddle said:

> "Besides the facilities offered by this invention for the working of coal mines abounding in fire-damp, it has enabled the directors and superintendents to ascertain with the utmost precision both the presence, the quantity, and correct situation of the gas. Instead of creeping, inch by inch, with a candle, as is usual, along the galleries of a mine suspected to contain fire-damp, in order to ascertain its presence, we walk boldly forward with the safety-lamp, and with the utmost confidence prove the actual state of the mine. By observing attentively the several appearances upon the flame of the lamp, in an examination of this kind, the causes of accidents which happened to the most experienced and cautious miners is completely developed, and this has hitherto been in a great measure matter of mere conjecture.
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> "It is not necessary that I should enlarge on the national advantages which must result from an invention calculated to prolong our supply of coal, because I think they must be obvious to every reflecting mind. But I can not conclude without expressing my highest admiration for those talents which have developed the properties and controlled the power of one of the most dangerous elements which human enterprise has hitherto had to encounter."

Sir Humphrey was complimented on all hands. In March, 1816, he received as a gift an elegant service of plate from the coal mine proprietors of the Newcastle coal field, and was at the same time the recipient of a public address, of which he was very proud, by the working miners, thanking him, in behalf of themselves and their families, for a discovery tending to the preservation of their lives. In 1825 he also received from the Emperor Alexander, of Russia, in compliment of his invention, a superb silver case standing on a circular tray enriched with medallions, and on the cover there was a figure representing the God of Fire weeping over his extinguished torch.

After the discovery of the safety-lamp, many mines which had been abandoned on account of the flow of fire-damp were reopened, and millions of tons of coal recovered.

George Stephenson, the celebrated engineer, invented his safety-lamp, the "Geordie," about the same time as Davy, and contested with Sir

Humphrey for priority of invention, but the credit was awarded to Davy. It appears that these two men, unknown to each other, had arrived at the same results. Stephenson's lamp had both gauze and glass around the flame, and possessed one advantage over that of Davy's—it became instantly extinguished when the gas was fired. In the hands of inexperienced fire-viewers, and in mines where safety-lamps have to be exclusively used, the "Geordie" is preferred to the "Davy," as being the safer lamp of the two; but for detecting the presence of fire-damp, the "Davy" is regarded by the ablest practical engineers as the best lamp yet invented. Mr. Stephenson was rewarded, like Davy, with suitable presents and public thanks; and though he failed to establish priority of discovery, the fact that he had, without any chemical knowledge whatever, and with scarcely any education, arrived at the same results as the distinguished chemist, was recognized and appreciated throughout the United Kingdom. Mr. Stephenson thus explains the manner by which he arrived at this discovery:

> "I was in the habit of making experiments upon blowers, and found that when they were lighted, and a number of candles held to the windward of the lighted blowers, the blowers were put out by the burned air which was carried towards them. Hence I conceived that if a lamp could be made to contain the burned air above the flame, and to permit the fire-damp to come in below in a small quantity, to be burnt as it came in, the burnt air would prevent the passing of explosion upwards, and the velocity of the current would also prevent it passing downwards."

When a Davy's safety-lamp is brought in contact with an explosive mixture of fire-damp, the gas explodes inside of the lamp, but does not ignite the gas outside, because the flame inside of the cylinder is unable to pass through, as the wires of the cylinder cool the burning flame sufficiently to prevent it from setting fire to the inflammable air outside. The burning gas inside of the cylinder, however, were the safety-lamp allowed to remain among the fire-damp, would soon heat the wires red hot and burn them through, when an explosion would follow. A current of inflammable air, moving at the rate of seven feet per second against a safety-lamp standing stationary, will also cause an explosion. Hence it will be seen that absolute safety is not attained by this invention. On the contrary, more men have been destroyed by explosions of fire-damp since the discovery of the safety-lamp than ever before. The lamp has in many cases been taken for license to neglect the ventilation—the best safeguard of all—and miners continue to tamper with it, notwithstanding the well-known danger and the most severe pains and penalties of law.

A great number of safety-lamps have been patented since Davy and

Stephenson made their discoveries. One by Dr. Clanny, called the "Clanny," is esteemed by fire-viewers, and is in very general use. In Belgium the Musseler lamp is the favorite. They are all covered by the wire-gauze cylinder. The great objection to every kind of safety-lamp is the feeble light they give, which tempts the miners to take off the top or gauze, and risk the consequence of an explosion.

Before the discovery of the safety-lamp the presence of fire-damp in coal mines was ascertained by the miner creeping cautiously forward along the mine, holding a lamp or candle in one hand and screening the flame with the two forefingers of the other, meantime keeping his eye intently fixed on the top of the light. As he reached the explosive compound, the top of the flame began to elongate and to assume a color of grayish blue. He stops at this juncture, and slowly raises his light towards the roof where the fire-damp floats. The flame now elongates into a sharp spire, the top changing from a grayish blue to a pure fine blue, and giving off minute luminous sparks. This is the extreme point of danger; a sudden movement of the body or a quick lowering of the lamp would cause an explosion. The miner lowers the lamp with great caution, and extinguishes the flame with his thumb and finger. This experiment, termed "trying the candle," was one of extreme peril, and was entrusted only to the more cool-headed of the miners. If the gas was not very copious, it was fired by means of "the firing-line." A light was attached to the end of a cord, that passed over a wheel at the wall-face; the light was then drawn into the fire-damp, while the miner retreated to a safe distance. Sometimes the miner would wrap himself in a wet jacket, and stretching himself flat on the floor would raise his light and explode the gas over his head. In France this person was sometimes called the penitent, as his head was covered by a mask resembling a monk's cowl, but he was more generally named the cannonier of the mine.

An explosion of a large volume of fire-damp in a coal mine is indeed a fearful catastrophe. The mine may be one thousand or one thousand five hundred feet below the surface, its various rooms and galleries extending several miles underground. Two or three hundred men and boys are at work. Some miner carries a naked lamp amongst an explosive mixture of inflammable gas. A terrific explosion follows. The burning air rolls like a tornado along the galleries of the mine, scorching every living creature to death within the reach of the blast. The divisions of the mine beyond the reach of the fire are visited by the force of the explosion; doors are broken to pieces, stoppings are blown down, men and horses are dashed to the ground, the cages in the shaft and even the pulleywheels are thrown high in the air. The choke-damp, the product of the explosion, strides through the mines and completes the work of death.

Black-damp, when it accumulates in a solid stratum, lies heavily upon the floor of the mine, sometimes for two or three feet in thickness, while the air above may be comparatively pure. It, however, readily diffuses itself with the common air. This gas has its sources from the lungs and bodies and excrementitious deposits of men and animals, the combustion of the workmen's lights, decaying timber, explosions of blasting-powder, and it also exudes from the fissures of the coal, and from the roof and floor of the mine. In its pure state it is a most deadly poison, and will neither support light nor life; but when diffused with certain proportions of atmospheric air, human life will exist for some time, even where the miners' lamps can not be kept burning. Carbonic acid gas was formerly called fixed-air by its discoverer, Dr. Black, of Edinburgh, from its existing so copiously in limestones and other solid substances. In a solid state carbon constitutes the diamond; charcoal and anthracite coal contain as high as ninety per cent. of carbon.

This gas, diffused through the air of coal mines, is, perhaps, ultimately more dangerous and deadly to the miner than even the fire-damp. It is insidious in its operations, and kills the workmen by inches. Its immediate effects are headache, langour, and general depression. Mines which give off no fire-damp are generally in a worse state of salubriousness than those which yield inflammable air. Where fire-damp exists, a sweeping current of air is generally made to traverse the working-faces of the mines, so as to dilute the gas and render it harmless; but where black-damp only is generated, the main object in too many cases seems to be, not to sweep the working-faces with a moving current of fresh air, but to provide just as much ventilation as will preserve the workmen's lights from dying out. And thus it is that, hourly plunged in a deleterious atmosphere, so many miners never grow old, but die.

White-damp is seldom met with in coal mines from natural causes, and is mainly produced from explosions of blasting-powder and from fires. When inhaled, it produces headache, giddiness, fainting fits, and insensibility, even when mixed with its own bulk of common air. In ancient times, when fires were used in mines to render the rocks brittle, the miners suffered greatly from the effects of this gas. Agricola, a German mining author, who wrote in the year 1556, describes at length the sufferings of the miners, induced by breathing the atmosphere of mines in which fires were used. The men were afflicted with headaches, difficult breathing, and sore eyes, and would sometimes fall back from the ladders when climbing up the shaft after the toils of the day, overcome by the dangerous emanations of the mines.

The Edinburgh Review, in an article on the mortality of trades and professions, referring to the diseases of the miners, says:

> "The miner's supply of oxygen is small; for, in all probability, the air supplied to him has to circulate many miles through the mine, and to pass over the excrementitious deposits of man and horse, and the decaying wood-work of the mines, ere it finally reaches him in enfeebled streams in his solitary working cell. Long deprivation of solar light, again, tends to impoverish his blood, to blanch him, in short, like vegetable products similarly deprived of the light of day. It is through the lungs, however, that the health of the miner is principally attacked. The air of a coal mine, such as it is, holds a vast amount of coal-dust in mechanical suspension, and this, as a matter of course, is constantly passing into the lungs of the miner. The proof of this is the so-called 'black spit' of the collier, which, on being subjected to the microscope, is found to consist of mucous filled with finely divided particles of coal. The permanent inhalation of such an atmosphere results in what is termed the 'black-lung.' The breathing apparatus of the collier becomes clogged, in short, with coal-dust, and after death has the appearance of being dipped in ink. The presence of this foreign body in the lungs leads to the whole train of pulmonary diseases. Asthma, bronchitis, and pneumonia are but too frequent, and we are, consequently, not surprised to hear that the aggregate amount of sickness experienced by this class for the period of life from twenty to sixty is ninety-five weeks, or sixty-seven per cent. more than the general average."

The more common diseases to which miners are subject are, sub-acute rheumatism, or chronic pains of the trunk and limbs, more particularly the back and loins, and affections of the chest and lungs. Rheumatic complaints are induced by working in water, or are caused by sudden changes from the mild temperature of the mine to that of the outside in cold weather; and diseases of the lungs result from breathing the foul air of the mines. When miners are attacked in their lungs, the shoulders rise, making the head look like sinking, as in ordinary consumption; the breathing apparatus becomes clogged up, and there is expectorated a black spit, which finally results in the black-lungs, or coal-miner's consumption.

Prof. Graham examined the lungs of a miner, the greater part of which were obliterated with a black, solid matter like lamp-black, and above an ounce of charcoal was obtained out of the mass.

Dr. William Thomson has recorded a number of cases of miners' lungs which were infiltrated with black matter. The following are some of the cases:

D. C. Age fifty-eight years; miner twelve years; lungs uniformly black and of a carbonaceous color.

D. D. Age sixty-two years; miner from boyhood; lungs uniformly black, not a vestige of natural color left; refers his disease to breathing an irrespirable atmosphere.

G. H. Age forty-five years; lungs uniformly deep black through their whole substance, with a density equal to caoutchouc.

L. A. Age fifty-four years; miner all his life; whole lungs dyed with black matter.

"Although pathologists do not agree," says Dr. Hutchinson, "about the exact cause of the origin of this carbonaceous matter—whether caused by mechanical inhalation of black matter, or by a chemical action of breathing carbonic acid gas, matters little to the miner. All agree that the lungs are blocked up with carbonaceous matter—by pit air—by something peculiar to the art of mining; and all agree that the more pure the air the more healthy the lungs. This allows me to urge for more air to circulate, for better ventilation, upon sanitary grounds alone."

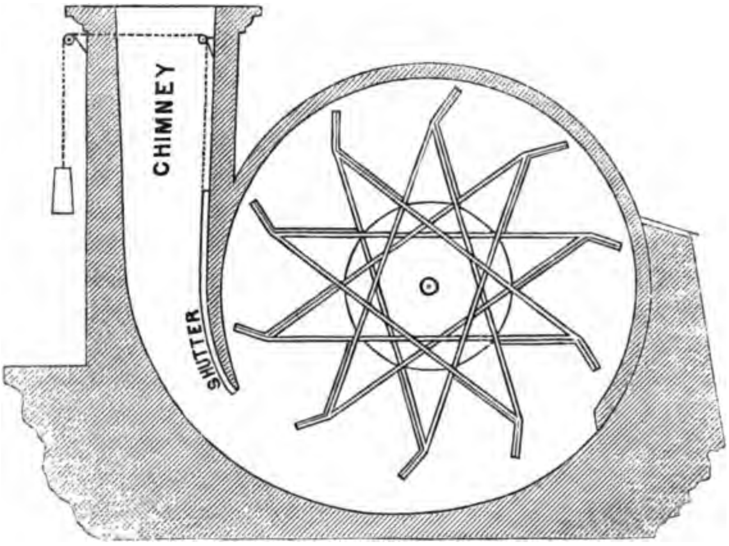
Ventilation.—Where two shafts or other openings are made into a mine of the same depth, and the tops and bottoms of both are in the same level, there can be no movement of air in the mine, even if the mine air and that of the surface be of different densities, because the pressure of the atmosphere in both shafts is equal; but if one of the shafts is sunk in higher ground, and is consequently deeper than the other, there is always a natural motion of the air, provided the temperature of the mine and that of the surface is of different densities. In winter, when the air of the mine is rarer and lighter than that of the surface, the current flows down the lower opening and up the higher one; and in summer these conditions are reversed, because the cooler column of air is then transferred to the higher opening. At certain seasons of the year, when the atmosphere above ground and that of the mine approach each other in density, there is again no motion, except what may be produced by the action of the cages in the shafts, or the movement of the cars along the galleries of the mine, or the direction and force of wind on the surface. In the language of the miners, the "pits fight"—the ventilating current sometimes going down one shaft, and in a few minutes reversing itself and going down the other; but in such cases it is weak and languid, and often assumes a state of rest. The unassisted forces of nature at such seasons of the year are wholly insufficient to create a current of air for the supply of even the smallest mines.

In very deep mines, where the increasing heat of the rocks maintains the temperature of the mine all the year round above the summer heat of the surface, the natural flow of air is constant in one direction, entering the lower opening and discharging itself at the higher one. It is, of course, very feeble in summer and very strong in winter. Hetton Colliery, in England, has been found to produce one hundred thousand cubic feet of air per minute on a cold winter day, by the natural forces.

The powers applied for the purpose of creating and maintaining a constant and necessary current of air in mines when the natural forces fail are many and various. The earliest means used for renewing the air mines, we are imformed by Pliny, was by diligently shaking a piece of cloth at the entrance of the mine. Fans and air-pumps were in general use in Agricola's time, and are described at length by that author. Some of these machines were capable of extracting the foul air from passages a quarter of a mile in extent. Waterfalls were formerly employed in coal mines to give motion to the air. A stream of water was poured into the downcast shaft, but as it had to be pumped out again it was let on very sparingly, and was a very expensive method. Steam jets were proposed by Sir Goldsworthy Gurney, in the year 1848, and for a number of years after were in high favor, as the danger in fiery mines of an explosion of fire-damp was avoided by the foul return current passing over the furnace, and they were believed also to produce better results than the furnace. But after an elaborate series of experiments, instituted by some of the ablest mining engineers of Great Britain, they were found to be greatly inferior to the furnace as a ventilating power, and are now very generally gone out of practice. Since the introduction of steam-pumps to discharge the waters of mines, exhaust steam is frequently used to promote a current of air, but although wholly inadequate to produce a vigorous ventilation, it is, in shallow mines, a great auxiliary to the furnace, and can be applied without any expense whatever.

Exhaust fans have long been the favorite ventilating power on the Continent of Europe, and they are now coming into practice in England and the United States. In Belgium the law forbids the use of a furnace in a fiery mine, and since the passage of the mines inspection law of Pennsylvania, which followed the Avondale catastrophe, the fan has become quite a favorite in the anthracite coal region. This accident, by which one hundred and nine human beings lost their lives, resulted from the furnace setting fire to the wooden structures in and on top of the shaft. The " Ventilation Act " provides that " the ventilation may be produced by blowing-engines, air-pumps, forcing or suction fans of sufficient capacity and power, or other suitable appliances, so as to produce and insure constantly an abundant supply of fresh air throughout the entire mine; but in no case shall a furnace be used in a mine where the breaker and shute buildings are built directly over and covering directly the top of the shaft." Guibal's fan is preferred to all others. It is generally made from fifteen to thirty feet in diameter, and from six to twelve feet wide, according to the requirements of the mine. It is inclosed in a case, having a stack from twenty to thirty feet long, extending upward.

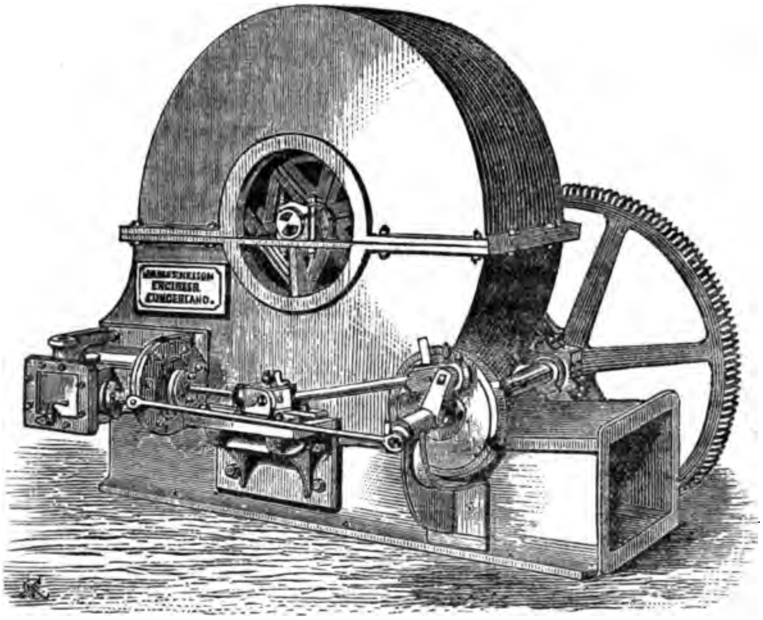
One of the largest mine ventilators in the world is a Guibal fan, forty-five feet in diameter and twelve feet face, at the Usworth Colliery, near Newcastle-on-Tyne. This fan runs about forty revolutions per minute, and is said to circulate two hundred thousand to two hundred and fifty thousand cubic feet of air per minute. It is driven by two first motion engines, thirty-six-inch diameter cylinders, three feet stroke. The upcast shaft is about ten feet in diameter, and six hundred feet deep. The workings in three seams are ventilated through it. The output of the Usworth Colliery is one thousand five hundred tons per day. The mines are very extensive. All the underground haulage is performed by macinery. Two of the three seams are worked on the board and pillar system; the other is worked on the long-wall plan.



GUIBAL'S FAN.

The Guibal fan at St. Hilda's Colliery, South Shields, lately constructed, is the largest fan of the kind yet erected in England; its diameter being fifty feet, and its width twelve feet. The patentee, Mr. Morrison, engaged to produce a sufficient ventilation for those extensive works, the Harton and St. Hilda's Colliery, by the action of this great fan, with a speed of twenty-eight revolutions per minute. It is found, however, that with a speed of twenty-two revolutions per minute the ventilation is amply sufficient for the purpose, and a much larger quantity of air is circulated at that speed than was formerly got by the furnaces. As the fan can be worked up to fifty revolutions per minute, the quantity of air can be greatly increased should any emergency arise to make it necessary to work at greater speed.

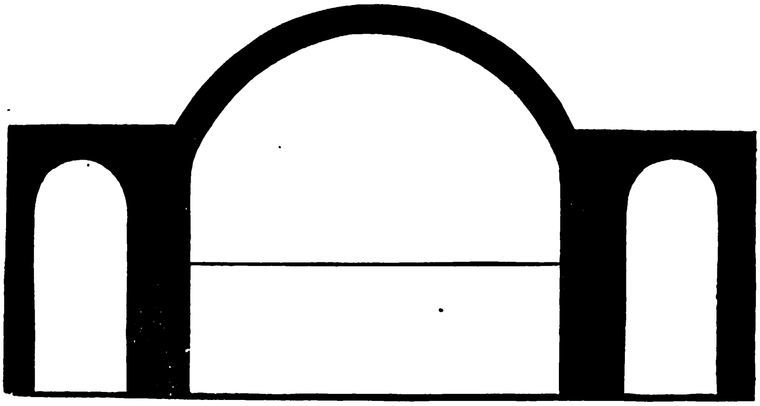
The Lenielle and Fabry fans are used in many mines in France and Germany, and Nixon's and Struve's ventilating pumps are at work in England and South Wales; but one serious fault to all mechanical ventilators is their liability to get out out of order and stop. In fiery mines this is considered by many able, practical men a fatal objection, because the stoppage of the ventilating currents, even for a few minutes, would flood the workings with gas, and imperil the lives of the whole underground population. For shallow mines, however, and mines which give off no inflammable gas, the fan is the best ventilating power in use.



IMPROVED FAN AND ENGINE.

The furnace has long been the favorite ventilating power in Great Britain and the United States, by reason of its simplicity and certainty. It is most effective in deep mines, because its power depends upon the amount of heat communicated to the air, and the longer the column of heated air there is in a shaft, the greater the velocity of the ventilating current becomes. This practical fact is not as well understood among practical men as it should be, and many a shallow mine is poorly ventilated, because, in addition to the physical imperfections of a shallow shaft, there is added a correspondingly small furnace. Mr. J. J. Atkinson, in his practical treatise on the general principles of ventilation, says: "Where furnaces are used to produce ventilation, the deeper the upcast shaft the better; because this gives rise to a longer upright column of hot air, and so causes a greater ventilating pressure, and, consequently, a brisker ventilation. Furnaces are not well suited for causing ventilation in shallow mines for this reason, and sometimes machines are fixed up at the top of the pit to pump the air through the mine. These machines, for the most part, exhaust the air of the upcast shaft, and the pressure of the denser air in the other, or downcast shaft, causes the current. Such a machine, like a furnace, acts by rendering the upcast column of air lighter, bulk for bulk, than the air in the downcast."

The proper place for the ventilating exhaust-fan is at the top of the upcast shaft; while the proper place for the furnace is at the bottom of the upcast shaft. Furnaces are sometimes placed on the top, but it is a mistake, no matter how limited the requirements of the mine may be. The best place for the furnace is back from the bottom of the upcast one hundred or one hundred and fifty feet, so as to avoid the danger of setting the wood-work of the shaft on fire. Many a fatal mining catastrophe has been caused by the too close proximity of the furnace to the woodwork of the upcast, of which the Avondale horror may be cited. The passage-way from the furnace to the air-shaft should be made to slant upwards, if it can be done, and should be of the same area as the air-shaft, and both should be proportioned to the size of the furnace. A large furnace and upcast shaft, with narrow air-ways, or spacious air-ways with a small furnace and upcast, can not produce good results.



FURNACE.

Where the air-courses are of thirty-six feet of sectional area, the furnace should be at least six feet wide and three feet high above the bars. A wide furnace will do better service than a high one of the same sectional area, because it admits of a thin fire, which more effectually heats the passing column of air. It is not necessary that the upcast shaft should be as large as the air-ways, as the sides of the shaft in too large an upcast do not become sufficiently heated, and a small shaft confines the ascending column too much. For a six-feet furnace, and thirty-six-feet air-ways, an upcast of from twenty-five to thirty feet of sectional area would be the approach to perfection. The upcast shaft should be free from falling water, to insure which there should be no hesitation in lining it throughout with incombustible material.

It is of great importance, in building a ventilating-furnace, to guard against the possibility of setting the coal-pillars on fire. This can be well insured by building an outer wall of brick on each side, between the furnace and the pillars. If the roof is fragile, the side walls should be used as pillars for its support. In no case should prop-wood or other combustible material be erected near the furnace. There is never any money lost in the construction of a good and sufficient furnace, and this is equally true of all the other requirements of good mine ventilation. Plenty of fresh air sweeping through every ramification of the mine, and a good track to haul out the coal, are two most important elements in successful mining.

In former times it was the general practice to pass the whole of the air around the workings in a single stream, termed "coursing the air." In fiery mines frequent explosions took place from the gas returning to the furnace in an undiluted state. It would fire in passing through the furnace, and flame backward, like a train of gunpowder, carrying death and desolation in its track. A torrent of water, called the "water-fall," had to be kept constantly on hand at the top of the shaft to be thrown down to extinguish the fire. In the year 1812 Mr. Buddle had his mind intensely occupied with this subject, and he invented the "dumb furnace," splitting the air at the bottom of the downcast shaft, and supplying the furnace with pure, fresh air direct from the surface, the foul return current being sent into the upcast shaft above the furnace fire by means of a dumb drift cut in the roof above the coal. Mr. Buddle was opposed in this plan by the miners, who contended that the air, by being split, would lose its ventilating force, but they were soon convinced to the contrary. This able viewer, who was justly regarded as the foremost miner of his day, continued to perfect this plan of splitting the air, and he divided the main ventilating column into a number of separate splits or divisions, sending each separate current to ventilate a separate section of the mine.

Since Mr. Buddle's time, an improved furnace has been devised by Mr. John Smith, an intelligent mining manager of the North of England. This furnace, also fed with fresh air direct from the downcast, has two brick arches above the fire for the passage of the return air, and has two air-gates, one on each side of the fire, to cool down the temperature between the brick work and the coal. The plan of splitting the air has also been greatly improved of late years.

Air, in its passage along the galleries of a mine, is greatly retarded in its progress by the friction which it encounters from rubbing against the roof, floor, and sides of the mine. The smaller the air-ways, and the further the air has to travel, the greater is the friction to which it is exposed; hence large air-ways move more air with the same ventilating power than small ones; and hence, also, short air-ways, with the same ventilating power, cause a brisker flow of wind than long ones. As it is expensive, and sometimes impossible to enlarge a single air-course so as to admit of a sufficient current for the requirements of the mine, an increased quantity is had by splitting the circulating stream into a number of splits or divisions. The several portions are each taken into different districts of the mine. Although the rubbing surface of the air-ways is not reduced by this means, the area of the air-channel is greatly enlarged, and the velocity of the separated currents is greatly reduced, which reduces the frictional resistance, and so, on the whole, produces a greatly increased current of air.

"Owing to the resistance offered by the shafts," says Mr. Atkinson, "we dare not have more than a limited number of splits in a mine; because, although every split adds to the total quantity of air in circulation, still, in each separate split the quantity ultimately becomes less and less, and if the number be too great, the current of each becomes too feeble and slow to sweep into the holes, corners, and places driven in advance of the actual current; and, besides this, powder-smoke is a long time in being carried away from the workmen. Still, it is a fact that an additional quantity of air, on the whole, is obtained from every new split that is made."

By splitting the circulating current into parts, and ventilating separate districts of a mine with independent splits or divisions of air, the ventilation is not only made purer and better, but in case of an explosion of fire-damp, the force of the blast is confined to the district where it occurs. Every split of the main current should be made as near the bottom of the downcast as possible, and no two or more splits should be allowed to reunite until after they have returned by independent routes towards the bottom of the upcast. By constructing over-throws in the mine, so that one current can pass over another without coming in contact, and by placing regulators in each separate air-course, so as to give each division of the mine its proportionate share of the main current, many a dangerous and fiery mine is made safe and healthy. Where one division or the mine is more dangerous than another, the split can be increased to meet the requirements of the case, and the intelligent manager is constantly borrowing and lending currents, as the demands of the various districts draw upon him.

In mines which are free from discharges of fire-damp, less elaborate arrangements will serve every requirement of health and safety. And for this reason such mines might be supposed to be always in an efficient state of ventilation. Unfortunately, the absence of fire-damp in a mine is too often taken as license for neglect in this matter of ventilation. In many a non-fiery mine the workmen are plunged all day in an almost stagnant and hourly-thickening atmosphere. Too frequently the workmen's lamps can only be kept burning by being hung downwards and to a post or to the pillar side. This condition of things is prompted by ideas of economy—to avoid driving the necessary air-courses, hanging doors, and building stoppings. But this policy of asphyxiating the miners is by no means true economy. The foul air of the mines not only prostrates the energies of the miners, so that they can not do a full complement of work, but it has also an injurious effect on the prop-wood, rails, and other wood-work of the mines, requiring their renewal every few years. Mr. Mackworth, Inspector of Mines, on dividing the quantity of coal brought out by the whole number of men employed in a large number of fire-damp mines, including the non-producing force employed in ventilating, and the quantity of coal brought out in an equal number of mines in which no fire-damp existed, and in which the air was bad, found that the men who wrought in the fiery seams, where good ventilation prevailed, did each considerably more work than those who worked in bad air. It has been estimated that a miner will do fully one-fourth more work in a mine in a good state of ventilation than in one in which the air is allowed to be in an impure state, and many a long and bitter miner's strike has had its origin in the foul and noxious air of the mine.

A number of instruments are used in connection with the ventilation of coal mines, to wit, the thermometer, the barometer, the anemometer, and the hygrometer.

The thermometer is used to ascertain the temperature of the air of mines, and also to find the difference of temperature in the upcast and downcast shafts, so as to be able to calculate the amount of pressure arising from the action of the ventilating furnace, or other power.

The barometer is of great value in giving notice of an increased escape of fire-damp in certain states of the weather. As the fire-damp is pent up by the counterpoising pressure of the atmosphere, any lessening of atmospheric pressure, as indicated by a fall in the mercurial column, is a sure presage of an extra flow of this gas, and calls for an increased volume of air in the mine. The great majority of mine explosions occur during a low state of the barometer. The more sudden the fall of the mercury, the greater is the danger of explosion. Not only does an undue escape of gas take place from the coal strata by a fall of the mercury, but the waste-air of the abandoned parts of the mine—an atmosphere frequently charged with an explosive mixture of fire-damp—expands in volume, and increases the danger of explosion.

The anemometer is used in measuring the amount of air which passes through the mine. Several of these instruments are in use, but Biram's is the favorite, both in Great Britain and the United States. It is an instrument easily understood, and self-registers the velocity of the current. Any slackening of the circulating stream by neglect of the furnace, or by obstruction of the air-ways, is at once detected by the lessening speed of the anemometer. Powder smoke is also sometimes used for ascertaining the speed of the aerial current in the mine.

By means of the hygrometer the proportion of moisture of the air of mines is ascertained. Mason's wet and dry bulb hygrometer is one of the best in use.

APPENDIX.

COLUMBUS, February 1, 1876.

The following circular was sent to every coal firm in the State:

STATE OF OHIO, OFFICE OF STATE INSPECTOR OF MINES,
COLUMBUS, December 31, 1875.

GENTLEMEN: Will you please furnish me on receipt, for publication in my forthcoming annual report, a statement of coal mined, number of men employed, etc., at your works for the year ending December 31, 1875?

The statement of coal mined will not be published except as the aggregate production of the county and State.

Name of mine, ———; county where located, ———; name of coal firm, ———; post-office address of same, ———; average number of men and boys employed on outside, ———; average number of men and boys employed on inside, ———; annual production of coal, ———; list of serious accidents, ———; list of fatal accidents, ———.

Very truly, etc.,

ANDREW ROY.

The returns came in very slowly, and some have not been returned up to the present time. The various companies are unusually busy settling up the business of the year. However, as the report did not go to press until the 1st of February, I delayed making any calculation until that time. Statistics are without value if they are not correct. I must add that some of the coal companies are adverse to furnishing a statement of the amount of coal mined by them, and few of them care to have the out-put of their mines published except as forming part of the aggregate yield of the county or State.

The number of fatal accidents which occurred during the year, in and around the coal mines of the State, amounts to twenty-four; twenty-one of the unfortunate persons were killed inside, and three outside. Eleven of these fatal accidents were caused by falls of roof and coal; four were caused by the caving in of a shaft in course of sinking; three by premature explosions; two by being run over by cars; two by falling down shafts, and the other three from other causes. The aggregate amount of people employed in and around the mines is 13,667, of whom 12,096 work in the mines and 1,373 work on top. The amount of coal mined was

4,868,252 tons. Part of the yield was estimated, no returns being sent in from the mines, but the above statement of the out-put of coal is at least approximately correct. One fatal accident, according to the above figures, occurred for every 202,677 tons of coal mined, and for every 561 persons employed.

In 1874 twenty-seven fatal accidents were reported, but three others, one of which occurred in Trumbull county, one in Perry county, and one in Tuscarawas county, were not returned in time for the report. My estimate of the coal production of the State for 1874 was stated at 3,820,000 tons, but later returns showed the out-put to be equal to 4,267,585 tons. The number of persons employed were 12,500. One death was then caused for every 142,252 tons mined and for every 417 persons employed. The number of serious accidents which occurred in 1874 amounted to eighty. This year only forty have been returned. There is, however, a probability that all the serious accidents were not reported, for in mining, as in war, there are three crippled to one killed.

The summary of the statistics of the British inspectors' reports for 1874 shows that with regard to those undertakings which are subject to the "Coal Mines Regulation Act," there were no accidents or deaths during the year in Ireland. In Great Britian there was an average of one fatal accident among every 602 persons employed in and about the mines, and one death by accident among every 510 persons. It will be observed that a "fatal accident" simply counts as one in the returns, although it may kill several persons; hence there is a difference in the ratio, according as we take the accidents or the deaths. It is also shown that 157.222 tons of minerals were mined for each fatal accident, and 133,251 tons for each death. In the preceding year (1873) the fatal accidents and the number of deaths from such accidents were more numerous in proportion to the number of persons employed, there being one accident among 526 persons, and one death from accident among 479. In proportion to the weight of minerals raised, the figures for 1873 showed one accident for 146,867 tons, and one death for 133,677 tons. Thus, on the basis of the work done, there was an improvement last year as compared with 1873 in the ratio of fatal accidents, but in regard to the actual loss of life the ratio was not quite so good as before, though the difference was so slight as to be scarcely appreciable. The fatal accidents from explosions of fire-damp were precisely the same in number last year as in the year preceding, namely, 44. The number of fatal accidents from the breaking of ropes and chains was also the same in the two several years, being 11 in each. In some other instances the two years show almost an exact equality in number of fatal accidents of a specified character.

With regard to the deaths from explosions of fire-damp, the figures show a great increase, being 166 for last year, as against 100 in the year preceding. But, of course, two or three heavy accidents will greatly aggravate the returns under this head for a single year. The deaths from the falls of the roof or sides of the mines show a considerable decrease, being 412 in 1874, as against 491 in 1873. The magnitude of these latter numbers, as compared with those under the head of fire-damp, shows that the terrible catastrophes which create so great a sensation in the public mind, are not the most fruitful source of destruction to the life of the miner. Deaths from accidents in the shaft were 154 last year, and 171 the year preceding. The deaths from miscellaneous accidents under ground were 214, as against 221 in 1873. The loss of life from accidents at the surface showed an increase, the deaths from this cause being 109, whereas in 1873 they were 86. Coming to the total there is a slight decrease, the deaths in 1874 being 1,056, as against 1,069 in the year before. The total number of mines was 4,332, employing 538,829 persons. The tons of minerals "wrought" amounted to 140,713,832, of which 126,590,108 were coal, the remainder being fire-clay, iron-stone and shale.

During the session of the Pennsylvania Legislature in 1870, the law enacted providing for the health and safety of persons employed in the anthracite coal mines of the State, divided the anthracite coal field into six inspection districts, in each of which an inspector of mines was appointed by the Governor. Since the passage of this law a vast amount of valuable and statistical information is annually published in the inspectors' reports. In 1873 the aggregate yield of the mines was 22,032,265 tons; the number of persons killed was 264, and the number seriously injured was 685. These figures show one death in the mines for every 83,457 tons mined, and a serious accident for every 32,140 tons mined. This is a most frightful list of mine casualties, and is greatly in excess of English mines, which for the same year only footed up one death for every 146,869 tons of mineral raised. The number of hands employed in the same year, at all the mines of the anthracite region, was 56,405, showing one death for every 213 hands employed in the same year in and about the mines, against one death for every 479 persons employed in and about the mines of Great Britian. The most dangerous mines of the anthracite region appear to be those of Schuylkill and Northumberland counties; one death being reported for every 52,055 tons mined.

The following gives the number of killed and maimed, etc., in all the anthracite districts in 1874:

	Killed.	Injured.	Widows.	Orphans.
Schuylkill	78	266	36	140
Northumberland	16	92	6	16
Columbia	2	8	....	....
Dauphin	8	16	1	6
Wyoming, Mid	57	105	29	69
" East	69	89	38	112
Lehigh	33	45	20	48
Totals	261	621	130	391
" in 1873	264	685	132	402

The following table gives the whole production in the anthracite regions in 1874, together with the proportion of coal mined for each person killed and maimed during the year:

	Product. Tons.	Death. Tons.	Accident. Tons.
Schuylkill	4,844,922	62,114	21,433
Northumberland	1,374,245	85,889	14,937
Columbia	290,923	145,961	36,365
Dauphin	478,481	59,810	29,280
Wyoming, Mid	4,513,847	79,190	42,084
" East	6,357,885	92,143	71,437
Lehigh	3,641,873	110,366	80,908

The product of all the regions gives one death for every 82,438 tons mined, and 34,647 for each accident.

"The total yield of the mines in Prussia, including salt-works, was, in 1874, 44,347,800 tons, representing a value of £21,480,121, against 45,149,421 tons, of the value of £22,958,301, in the previous year. The year 1874, consequently, shows a decrease, in quantity, of 1.66 per cent.; in value, of 6.44 per cent. The decline was mainly in the production of the iron-ore mines and of the coal mines. The yield of iron fell from 3,555,005 tons in 1873 to 2,540,886 tons in 1774, the latter year thus showing a decrease in the production of no less than 1,014,115 tons, or 28.53 per cent.. Corresponding with this decrease in quantity, there was a decline in value against the previous year of £776,384, and a reduction in the number of miners of 10,747 men. The quantity of coal produced in 1874 amounted to 31,938,683 tons, against 32,347,709 tons the year previous, thus showing a decrease of 409,226 tons, involving a decline in value of £838,037. The decrease in value of the iron and coal production (1874 against 1873) is, consequently, no lesss than £1,614,421, an amount higher than the decrease in value which the production of the Prussian mines, amounting only to £1,478,180, represents. The causes of this phenomenon must be sought in the steady progress of a few other branches of mining—brown coal, lead ore, and zinc ore—which make up for the great deficiency in the iron ore and coal production. The salt-works show a total production for the year 1874 of 4,305,664 cwt. of salt, of the value of £292,118, against 3,822,574 cwt., representing a value of £257,300, the year previous. This is, consequently, an increase in this branch against the preceding year of 483,154 cwt., or 12.64 per cent., of a value of £34,718, or 13.53 per cent. The numbers of the mines at work were as follows:

	In 1873.	In 1874.
Coal mines	506	501
Brown coal mines	577	549
Iron ore mines	1,539	1,121
Zinc, lead, and copper ore mines	262	262
Other mines	79	92
Salt works	32	31
Totals	1,995	2,556

In 1874, therefore, 439 mines (of which 418 were iron-ore workings) and one salt-work less were being worked than the preceding year. The numbers of workmen employed were:

	1873.	1874.
Miners	241,196	239,884
Men employed in salt-works	1,757	1,857
Totals	242,953	241,741

Which is 1,212 men less in 1874 than in 1873.—[*Mining Journal.*

THE STORE-ORDER SYSTEM.

This is an evil which is growing in magnitude, and is deserving the serious attention of the Legislature. Working-men, instead of receiving pay in the lawful currency of the State, are paid in store-orders, or in scrip, at many mines, mills, furnaces, and other industrial establishments. In these dull times, and low wages, it places the working-man in a state of semi-feudalism. The system has already attracted the attention of some of the State Legislatures, and a bill is now before the General Assembly of Pennsylvania requiring that all employes engaged in mining and manufacturing shall be paid in lawful money of the United States, and that goods, wares, merchandise, or commodities of any kind shall not be considered as pay.

I copy the following letter from one of the most intelligent working miners in the State on this subject:

SODOM, TRUMBULL COUNTY, OHIO, *January* 24, 1876.

HON. ANDREW ROY, *State Inspector of Mines, Columbus, Ohio:*

I desire to call your attention to a subject of great importance to the laboring masses of the State, causing much suffering and discontent, and growing in magnitude—the "truck system," as it is generally called.

The mine-owners have a store at the mines, in which the goods kept are, as a rule, of a cheap and inferior kind, but they are sold to miners at the highest figures. The miners, instead of being paid in money, either receive store-scrip or store-orders, which will purchase goods at only one store—that owned or controlled by the coal company. If the company does not own the store, they receive five per cent. back on all orders issued, for giving it the patronage of the mine. The orders read like this: "Mr. A. B., pay to the order of C. D., in merchandise, $5, and charge E. F." This five per cent. comes out of the miner by being added on the goods he purchases, and is equal to two and a half cents per ton of a reduction of wages.

It may be urged that miners are not compelled to purchase goods at this store; but take this case: In the mine where I am working we are paid once a month—that is those of us who have any money coming at pay-day. When a man commences work in this mine he has to wait forty-seven days before he gets his first pay. In these dull times, and low wages, a working-man with a small family *is* compelled to take store-orders or scrip, or starve; for who can wait forty-seven days on pay?

To correct this evil, we want pay every two weeks, so that we can get money and buy for cash; and I would suggest that a law be passed for this purpose. Of course, the employers of labor will exclaim that they can not get money, and that such a law would bring disaster to *their* interests and to ours. But this law would act like the mining law. *That* law was going to ruin the coal business of the State. So they said. Look at England. Working-men are there paid every week in lawful currency—not in store-orders nor in scrip—and such is the law of the realm, and the money is always forthcoming on pay-day. Every true-hearted laborer, and every honest merchant, would hail the passage of such a law by our Legislature. It would be hailed by the miners as the inspection law was hailed, as good air in their working places is hailed, and as good props under the roof make us feel safe, because it would enable us to go with ready money to the cheapest market to purchase wholesome food and good clothing, and would remove a growing feeling of discontent at the mines. Now, in this year of our Centennial independence, I urge you to bring this matter before the attention of the Legislature.

Very respectfully,

DAVID OWENS.

TRAVELING AND OTHER EXPENSES.

From the day upon which I received my commission, I have been almost constantly employed in the mining regions of the State, visiting and inspecting the mines, to see that the law was enforced and obeyed; making such suggestions for improving the condition and manner of working the mines as would conduce to the health and safety of the miners and to the economy of the mining operators. I knew, unless periodical visits were made to the mines, the law would be of no avail. I have traveled on foot under ground fifteen hundred miles. At every mine I have been received with the greatest courtesy, and every assistance has been given me, on the part of the mine-owners and superintendents, to make a thorough examination of the mine.

My traveling expenses have been made as light as it was in my power to make them. I made conscience of every cent expended, and did for the State what I would have done for myself. Some of the railroad companies extended to me the courtesy of an annual pass; in all cases where I have not been charged railroad fare, I have not charged the State. In passing from one mine to another, I have never hired a horse or a rig of any kind, unless the distance exceeded four miles, but walked on foot.

All opposition to the inspection of the mines by State authority may be said to be now wholly disarmed. After two years of trial, those who were opposed to the law, fearing it would cause trouble and strikes among the miners, have acknowledged their mistake. In visiting a mine, it was not for the purpose of annoying the company or the mine superintendent, but for the purpose of getting the mine improved as the law required; to do good and not evil; to make peace and not strife. I came as a friend, not as an enemy—as the friend of both; and I now receive letters from coal companies requesting me to make visits to the mines, especially those that are thought to be dangerous; for such visits satisfy the miners and allay the feelings of fear.

STATEMENT OF CONTINGENT EXPENSES FOR THE YEAR ENDING DECEMBER 31, 1875.

Date.	For what purpose paid.	Amount.
Jan. 6–14	To visiting mines of Mahoning Valley and Salineville	$31 50
19	To express charges on two lithographs for report	2 25
19–23	To visiting mines at Coshocton and Port Washington	14 30
25–29	To visiting mines at Straitsville and Federal Creek	8 45
31	To express charges on maps, and postage stamps	3 10
Feb. 8–12	To visiting mines at Akron and Wadsworth	17 25
15–20	To visiting mines at Coshocton, Urichsville, and New Philadelphia	18 40
22–23	To express charges on maps	85
23–28	To visiting mines in Medina county	10 25
March 4	To purchasing Inspector's note-book for office	22 00
10	To postage stamps	2 00
15–19	To visiting mines in Mahoning Valley region	12 75
19	To postage stamps	2 20
21	To binding report and purchasing mining-book	5 00
22–26	To visiting mines at Straitsville	5 00
April 5–14	To visiting mines at Steubenville and Bellaire	26 40
14	To postage stamps	1 00
15–18	To visiting Massillon and Coshocton mines	12 40
20–25	To visiting Zanesville and Macksburg mines	15 04
April 27 to May 2	To visiting mines on Muskingum river	15 40
May 2	To postage stamps	3 00
5–10	To visiting mines at Bellaire region	19 50
18–20	To visit to Straitsville mines	4 00
26–31	To visit to Zanesville, Cambridge, and Bellaire mines	19 15
June 9–13	To visit to Vinton county mines	8 45
14–15	To visit to Nelsonville mines	5 85
16–18	“ “	5 50
22–24	To visit to Shawnee mines	4 00
24–26	To visit to Wellston mines	5 50
27	To postage stamps	1 50
July 7–17	To visit to Belmont county mines, Steubenville, Ironton, etc	35 40
20–25	To visit to Tuscarawas Valley	22 50
Aug. 1– 6	To visit to Mahoning Valley mines	16 40
16–21	“ “ “	13 21
23–28	To visiting Coshocton mines	15 90
Aug. 31 to Sept. 5	To visiting Salineville mines	16 40
Sept. —	To postage stamps	3 00
15–23	To visit to Hocking Valley mines	7 65
23	To postage stamps	3 00
Sept. 25 to Oct. 6	To visiting mines of Summit county, North Lawrence, and Canton on law suit	40 40
Oct 8	To express charges on map, and two telegrams	2 35
11–12	To visiting Longstreth's mines	4 50
15–16	To visiting Cambridge mines	7 90
17	To postage stamps	4 00
17–23	To visiting Mahoning Valley mines	16 40
26–29	To visiting Shawnee mines	7 50
Oct. 29 to Nov. 3	To visiting Vinton county mines	6 00
Nov. 3	To two map cases and express charges on same, and entry maps.	13 75
9	To visit to Cleveland on law suit *v.* Mahoning Coal Company	7 50
15–19	To visiting mines of Leetonia and Mineral Ridge	22 75
23–25	To visiting Wadsworth slope	9 50
Dec. 13	To express on reports	1 80
15	To postage stamps	2 00
26	“ “	16 25
26–29	To visiting Wadsworth slope	12 40
	Total	$610 48

LIST OF SERIOUS ACCIDENTS.

Name.	Name of Mine.	Cause of Accident.	Nature of Accident.
John Flannagan	Cleveland shaft	Fall of coal	Leg broke.
A. Swede	Foster shaft	Fall of roof	Back broke.
Pat. Griffith	Beech Hollow	Fall of slate	Back broke.
I. Graham	Coshocton	Fall of slate	Injury not stated.
Dan. Pascoe	Newark Coal Company	Fall of coal	Seriously bruised.
John Tares	Lick Run	Fall of car	Seriously hurt.
Ed. McConachy	Scott's mines	Riding on loaded car	Hurt in back and side.
Geo. Lark	Minersville	Riding on cars	Crushed badly.
Ben. Lewis	Dabney	Fall of slate	Back and limbs.
John Burns	Wadsworth slope	Premature blast	Head and breast.
John Ballantine	Sodom slope	Fall of slate	Back and limbs.
I. French	Sodom slope	Fall of slate	Back and limbs.
Thos. Rosdoer	Shenango slope	Fall of coal	Leg broke.
Anthony Broadis	Longstreth mine	Caught between cars	Body bruised.
De Witt Washburn	Longstreth mine	Fall of roof	Body bruised.
Geo. Swindle	Longstreth mine	Caught between cars and pillar	Body bruised.
John Flannagan	Central mine	Fall of coal	Body bruised.
David G. Roy	Central mine	Run over by cars	Leg broke.
Jos. Woodward	Farmers' mine	Fall of coal	Collar-bone broke.
Adam Rhinehart	Johnson shaft	Fell under engine	Injury not stated.
Geo. Washburn	Longstreth mine	Fall of slate	Injury not stated.
David Vaughn	Syracuse slope	Fall of slate	Injury not stated.
Eli Cook	Wellston shaft	Fall of slate	Thigh broke.
John McCulloch	Star Furnace shaft	Explosion of fire-damp	Face and arm bruised.
John Cochrane	Star Furnace shaft	Explosion of fire-damp	Face and arm bruised.
Henry Bowen	Vienna	Caught between cars	Injury not stated.
Wm. Young	Wheeler slope	Premature blast	Face and head crushed.
August Turncout	Wheeler slope	Fall of slate	Face and head crushed.
John Disclin	Del Carbo	Fall of roof	Face and head crushed.
Thos. Davis	Johnson shaft		Hand crushed.
Crist. Wheat	Pittsburgh Works	Sinking shaft	Back hurt.
A. McElheny	Pittsburgh Works	Sinking shaft	Back hurt.
Jas. Hemelin	Martin's Ferry	Fall of slate	Not stated.
John Mossop	Burton City	Fall of roof	Back hurt.
Richard Gorman	Maple Grove	Fall of roof	Back hurt.
Jas. Shenard	Shawnee	Fall of coal	Leg broke.
Wm. Nesbet	Long bank	Fall of coal	Body and limbs.
Phil. Carosella	Long bank	Fall of coal	Body and limbs.
John Schloser	Buckeye	Fall of slate	Back hurt.
John Pruthers	Pomeroy	Premature blast	Face and breast.

LIST OF FATAL ACCIDENTS.

Date.	Name.	Name of Mine.	Cause of Accident.
1875.			
March 4	Petereen Bianka	Church Hill	Fell down shaft.
6	Henry Ohlinger		Fall of slate.
15	Anthony Whalen	Shawnee	Run over by cars (outside).
April 12	John Shenhalter, Peter Shenhalter, George Orr, and Peter Adams	Pigeon Run shaft, Massillon.	Caving in of shaft.
	William Carlisle	Helen's mine	Fall of earth (outside).
July 1	James Patterson	Pittsburgh Works	Fall of roof.
	George Fry	Pittsburgh Works	Fall of roof.
Aug. 17	Joseph Stitts	Salineville	Fall of trestle (outside).
23	Frank Fox	Packard slope	Fall of roof.
Sept. 1	John Rice	Kyle shaft	Premature blast.
3	M. Sprague		Fall of roof.
22	C. Cubers	Burnett slope	Fall of roof.
28	Henry Benin	Massillon Coal Company	Fall of slate.
30	Jacob Miller	Rhodes shaft	Fell down shaft.
Oct. 8	David Cummins	Longstreth mine	Fall of roof.
12	James Harris	Longstreth mine	Fall of slate.
22	James McIntosh	Pennel slope	Premature blast.
Nov. 6	Thomas B. Thomas	Brookfield slope	Fall of rock.
Dec. 27	Gatanes Reetz	Stewart mine	Explosion of powder.
28	William Flint	Rush Run	Fell down shaft.

STATEMENT OF NUMBER OF MINERS AND AMOUNT OF COAL MINED IN THE SEVERAL COUNTIES DURING THE YEAR 1875.

COUNTIES.	No. of Miners.	Production in tons.	No. of drifts.	No. of slopes.	No. of shafts.	Total number.
Athens	887	329,503	12	0	4	16
Belmont	514	213,955	10	5	1	16
Carroll	150	60,000	5	1	1	7
Columbiana	967	332,446	18	1	1	20
Coshocton	251	90,669	9	0	0	9
Guernsey	295	135,425	4	0	1	5
Gallia	20	5,420	2	0	0	2
Hocking	429	170,034	3	0	0	3
Holmes	40	14,000	1	0	0	1
Harrison	10	5,300	1	0	0	1
Jefferson	465	195,265	7	0	13	20
Jackson	267	117,730	3	1	7	11
Lawrence	355	122,484	5	0	0	5
Medina	228	80,000	0	2	0	2
Mahoning	774	271,689	2	9	8	19
Muskingum ‖	380	109,480	10	0	1	11
Meigs	917	345,500	11	1	2	14
Noble	30	4,000	1	0	0	1
Perry	1,236	503,169	24	0	0	24
Stark	795	408,180	1	5	12	18
Summit	735	274,876	3	6	2	11
Tuscarawas	358	107,000	9	0	2	11
Trumbull	2,551	749,059	1	20	6	27
Vinton	225	56 356	4	1	0	5
Wayne	240	80,291	2	0	2	4
Washington	72	12,425	3	0	0	3
Small mines	300	80,000				
Totals	13,669	4,868,252	151	52	63	266

LIST OF MINES, TOGETHER WITH NAMES OF OPERATORS, ETC.

ATHENS COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Lick Run	Drift	I. W. Scott	I. W. Scott	Nelsonville.
Laurel Hill	"	T. P. Marshall	Laurel Hill Coal Co	Bretland.
Section 29	"	Wm. Comstock	W. B. Brooks & Son	Nelsonville.
Harper's	"	Benj. Harper	Harper Brothers	Nelsonville.
Co-operative	"	John F. Welsh	Nelsonville Mining Co	Nelsonville.
Poston's	"	John Burbury	Poston Brothers	Nelsonville,
Longstreth's	"	Thomas Berry	T. Longstreth	Nelsonville.
Star	"		Star Mining Co	Nelsonville.
Doanville	"	John McGinnity	N. Y. & O. Coal Co	Nelsonville.
Floodwood	"	Joseph Wolf	B. B. Sheffield & Bro	Floodwood.
Hamley's Run	Shaft	Wm. Cornell	G. F. Gould	Athens.
Salina	"	G. F. Gould	"	Athens.
Chauncey	"			
Big Run*	"	I. Morrow	Federal Creek Coal Co	Big Run.
Carbondale	Drift	Joseph Armstrong	Carbondale Coal Co	Mineral City.
King's	"	D. McDermott	King Brothers	King's Switch.

BELMONT COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Barnesville	Shaft			
Steward's	Drift	Stewart & Mehan	Stewart & Mehan	Stewardsville.
Kidd's	"	John Kidd	Kidd Brothers	Shields.
Rainey's	"	Thomas John	W. J. Rainey & Co	Cleveland.
Etna	"	Ed. Herbert	Etna Iron and Nail Co	Martin's Ferry.
Helling's	"	Henry Helling	Henry Helling	Martin's Ferry.
Ohio City	"		Ohio City Iron and Nail Co	Martin's Ferry.
Belmont Works No. 1	"	Jacob Heatherington	Heatherington Brothers	Bellaire.
Belmont Works No. 2	"	same	" "	Bellaire.
Pittsburgh Works	Slope	John Hines	Rochinhouser & Sterrett	Bellaire.
Empire	"		Thomas Corcoran	Shawnee.
Weegee	"	Thos. Jones	P. Shafar & Co	Weegee.
Union Works	"	C. Cunningham	Union Coal Co	Moundsv', W.Va.
Pipe Creek	"	Wm. Babel	Pipe Creek C. and I. Co	Dilley's Bottom.
Barnard's	Drift	Thos. Nicholson	W. G. Barnard	Bellaire.
Morgan's	"	S. W. Coss	E. G. Morgan	Bellaire.

‖ The estimated production of this county includes small mines.

CARROLL COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Robertsville No. 1	Drift	Thos. Yates	Cleveland Iron Co	Salineville.
Robertsville No. 2	"	same	" "	Salineville.
Brown's Strip Vein*	"	Mathew Brown	Mathew Brown	Salineville.
Brown's Big Vein*.	"	same	"	Salineville.
Dutchen & Davis	"		Dutchen & Davis	Salineville.
Tunnel Hill	Shaft		I. C. Card	Cleveland.
Welsh Mines	Slope	T. Brickmann.	McDowell & Pratt	Mineral City.

COLUMBIANA COUNTY.

Washingtonville No. 1	Drift	Zack Titlow	Cherry Valley Iron Co	Leetonia.
Washingtonville No. 2	"	same	" "	Leetonia.
Leetonia Slope	Slope	same	" "	Leetonia.
Grafton	Shaft	Frank Rooney	Grafton Iron and Coal Co	Leetonia.
Empire	Drift	Wm. Houston	John Hayes & Co	Salineville.
Hayes'	"	Jacob Smith	" "	Salineville.
Farmer's	"	Geo. H. Sharp	Jas. Farmer	Salineville.
Hartford	"	Edmund Boyle	O. and P. Coal Co	Salineville.
Rockville	"	James Black	" "	Salineville.
O. and P	"	same	" "	Salineville.
Granage & Anderson	"	James Smith	Manufacturers Coal Co	Salineville.
Foster	"	Sampson Sharp	Harding & Sharp	Salineville.
Hussey Hollow	"		O. and P. Coal Co	Salineville.
Truesdale	"		Truesdale Coal Co	Salineville.
Robins'	"	H. H. Bowmann	New Lisbon Coal Co	New Lisbon.
Foster Mine	"		Shields Coal Co	Teegarden.
Rose Mine	"		Thomson & Coleman	Teegarden.
State Line	"		State Line Coal Co	East Palestine.
Prospect Mines	"		Prospect Coal Co	East Palestine.
O. and P	"		O. and P. Coal Co	Salineville.

COSHOCTON COUNTY.

Union	Drift	W. S. Wood	Union Coal and Mining Co	Coshocton.
Blaen Nant	"	Ed. Prosser	Edward Prosser	Coshocton.
Rock Run	"		Rock Run Coal Co	Coshocton.
Summit	"	L. L. Scott	Franklin and Coalport Coal Co.	Coshocton.
Coshocton	"	Jas. E. Evans	Coshocton Coal Co	Coshocton.
Diamond	"		Diamond Coal Co	Coshocton.
Cunesville	"		Ressler & Co	Newark.
Pen Twyn	"	Ed. Prosser	Pen Twyn Coal Co	Coshocton.
Home	"	same	Home Coal Co	Coshocton.

GUERNSEY COUNTY.

Scott's	Drift	Jas. C. Wilson	Scott Coal and Salt Works Co.	Cambridge.
Cambridge	"		Cambridge Coal and Mining Co	Cambridge.
Central	Shaft	Wm. Norris	Wm. Norris	Cambridge.
Nicholson	Drift		Ohio Coal Co	Marietta.
Guernsey	"		Guernsey Mining Co	Cambridge.

GALLIA COUNTY.

Leadington	Drift		Leadington Coal Co	Cheshire.
Cheshire	"	C. A. Card	Cheshire Coal Works Co	Cheshire.

HOCKING COUNTY.

Section 19	Drift	Wm. Comstock	W. B. Brooks & Son	Nelsonville.
Hayden's	"	T. Jones	Peter Hayden	Haydenville.
Gore*	"		Straitsville and Monday Creek Coal Mining Co	Gore.

HOLMES COUNTY.

Hardy	Drift	Jas. Conner	Hardy Coal Co	Millersburg.

HARRISON COUNTY.

Philadelphia	Drift	W. E. Williams	Philadelphia Coal Mining Co	Station 15.

JEFFERSON COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Market Street	Shaft	Wm. Smurthwaithe	Steubenville Coal Mining Co	Steubenville.
Stony Hollow	“	same	“ “ “ “	Steubenville.
Gravel	“	Jas. Duffy	Steubenv' Furnace and Coal Co	Steubenville.
Everick's	“	John Smurthwaithe	O. and P. Coal Co	Steubenville.
Boreland's	“	Thos. Ritson	Cincinnati Coal and Coke Co	Steubenville.
Rolling Mill	“	Robt. Thomson	Spaulding, Woodward & Co	Steubenville.
Mingo	“	John Cram	Mingo Iron Works Co	Mingo.
La Grange	“	John Lowe	La Grange Coal Co	Philipsburg.
Rush Run	“	John Nicholson	Peck & Ramsey	Rush Run.
Bustard's	“	Thos. McNamee	Steubenville Coal and Coke Co.	Steubenville.
Alikana	“	John Knox	Bell & Co	Steubenville.
Cable*	“			
Irondale No. 1*	Drift		Morgan Iron Co	Irondale.
Irondale No. 2*	“		“ “	Irondale.
Irondale No. 3*	“		“ “	Irondale.
Hammondsville*	“		Hammondsv'e Coal and Coke Co	Hammondsville.
Strip Vein	Shaft	H. W. Wallace	Wallace & Sons	Hammondsville.
Diamond	Drift	same	“ “	Hammondsville.
Strip Vein*	“		Morgan Iron Co	Irondale.
Big Vein*	“		“ “	Irondale.

JACKSON COUNTY.

Wellston	Shaft	J. Stewart	Wellston Coal and Iron Co	Wellston.
Milton	“	John Hall	Milton Furnace and Coal Co.	Wellston.
Star	“	Henry Price	Star Furnace Co	Jackson.
Tropic	“		Tropic Furnace Co	Jacksan.
Orange	“		Orange Iron Co	Jackson.
Globe	Slope	Jas. Harper	Globe Iron Co...	Jackson.
Huron	Shaft	D. S. Jones	Huron Iron Co	Jackson.
Erie	“		Erie Iron Co	Jackson.
Jackson Hill	Drift	Price Brothers	Price Brothers	Jackson.
Petrea	“		Petrea Coal Co	Jackson.
Jackson Hill	“	Thos. M. Kitrick	Thos. M. Kitrick	Jackson.

LAWRENCE COUNTY.

Sheridan	Drift	Henry Pickering	Sheridan Coal and Iron Co	Sheridan.
Hanging Rock	“	E. B. Williard	Means, Kyle & Co	Ironton.
Bellford	“		Norton Bros. & Co	Ironton.
Old Mill	“	Thomas Winters	Iron and Steel Co	Ironton.
Lawrence	“	George Watson	Lawrence Iron Works Co	Ironton.

MEDINA COUNTY.

Wadsworth	Slope	Philip Reese	Wadsworth Coal Co	Akron.
Diamond	“	H. Coleman	Humphrey & Coleman	Akron.

MAHONING COUNTY.

Foster	Shaft	Jonathan Head	Foster Coal Co	Youngstown.
Osburn	“	Alex. McIntosh	Andrews Bros	Youngstown.
Kyle	“	Jonathan Oatey	Kyle Coal Co.	Youngstown.
Wick and Wells†	“	Evan Edwards	Wick and Wells	Youngstown.
Austin	“	James Jones	John Morris & Co.	Mineral Ridge.
Ohltown	“	David Jones	Harris & Maurer	Mineral Ridge.
McKennie's Shaft	“	David Williams	J. B. Warner & Co.	Mineral Ridge.
Tibbett's Shaft	“	Jacob Williams	Junction Coal Co.	Mineral Ridge.
Foulk's	Slope	R. Perkins	Foulk Coal Co	Mineral Ridge.
Pennel	“	Frank McIntosh	New Lisbon Coal Co	Youngstown.
Haroff	“	James Jones	Haroff Coal Co	Youngstown.
Thorn Hill	“	Abel Dore	Powers and Arms	Youngstown.
Packard's	“	Jacob Henry	Packard Coal Co	Youngstown.
Powers's	“	Clark Powers	Powers Coal Co	Youngstown.
Holland	Drift	Reese Charles	Charles Moore & Co.	Youngstown.
Jackson	Slope	George Head	Jackson Coal Co	Youngstown.
Reno's	“			
McKenny Slope	“	John Jones	Mahoning Coal Co.	Youngstown.
Walter's	Drift	—— Walters	Walters & Sheets	Washingtonville.

MUSKINGUM COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. Address.
Zanesville Mines	Drift	John Marpool	John Marpool	Zanesville.
Del Carbo	"	B. F. McCloud	Diamond Mining Co	Roseville.
Muskingum Valley	"	J. E. Downing	Muskingum Valley Coal Co	Roseville.
Matthew's	"	Lewis Matthews	Lewis Matthews	Zanesville.
Monitor	Shaft	Hiram Cowell	Cowell, Harris & Co	Zanesville.
Locust Grove	Drift	James Owens	James Owens	Putnam.
Harper's Ferry	"	James Morrison	James Morrison	Putnam.
Ballou's	"	Orin Ballou	Orin Ballou	Zanesville.
Scarval's	"	G. Scarval	G. Scarval	Philo.
Crow Run	"	Charles Stone	Stone & Deval	Cedar Run.
Blue Rock	"	James Paterson	James Paterson	Blue Rock.

NOTE.—There are from twenty-five to thirty other mines in this county, in the neighborhood of Zanesville, but they all work less than ten men at once.

MEIGS COUNTY.

Antiquity	Shaft		Ohio Coal Co	Racine.
Syracuse Shaft	"	John Blair	Syracuse Coal and Salt Co	Syracuse.
Syracuse Slope	Slope	M. Nye	M. Nye & Sons	Syracuse.
Pamunky	Drift		Pomeroy Coal Co	Pomeroy.
Williams's	"	Evan Williams	Evan Williams	Minersville.
Minersville	"	Thomas Middleton	Pomeroy Coal Co	Pomeroy.
Excelsior	"	same	" "	Pomeroy.
Pencreek	"	same	" "	Pomeroy.
Dabney	"	same	" "	Pomeroy.
Diamond	"	same	" "	Pomeroy.
Coal Ridge	"		Coal Ridge Salt Co	Pomeroy.
Buckeye	"		Buckeye Salt Co	Pomeroy.
Middleport	"		Middleport Salt Co	Middleport.
Pomeroy's	"	Thomas Hedley	S. M. Pomeroy	Pomeroy.

NOBLE COUNTY.

Dexter	Drift	A. Wyper	Ohio Coal Co	Marcella.

PERRY COUNTY.

Central	Drift	David W. Roy	Straitsville Central Mining Co.	New Straitsville.
Old Straitsville	"	Ed. Martin	Straitsville Mining Co	New Straitsville.
Plummer Hill	"	John Sines	Straitsville Coal Co	New Straitsville.
Troy	"	Wm. Job	Straitsville Coal and Iron Co	New Straitsville.
Hillyer's *	"		Lancaster & Str'tsv'e Coal Co	New Straitsville.
Mungen's	"	Wm. Gibson	Great Vein Coal and Iron Co	New Straitsville.
Youart's	"	R. Youart	Patterson Coal Co	New Straitsville.
Upton's	"	Reese Williams	Card and Upton Coal Co	Shawnee.
Upton's Mines, Nos. 1, 2, 3	"	James Findlay	Newark Coal Co	Shawnee.
New York	"	Sam Butts	N. Y. and Straitsville Coal Co	Shawnee.
Lyonsdale	"	Thomas Corcoran	S'ts'e & Canuel C. Co., of N. Y.	Shawnee.
Furnace	"	Rob Pearson	Furnace Coal Co	Shawnee.
Shawnee Valley	"		Shawnee Valley Coal Co	Shawnee.
Taygue's	"	P. Taygue	M. & P. Tague	McLuny's.
Jones's	"	H. Jones	H. Jones & Co	McLuny's
Tunnel Hill	"		Tunnel Hill Coal Co	New Lexington.
Selby	"		Selby Mining Co	New Lexington.
Wales's	"		Wales, Nugent & Co	New Lexington.
Crookville	"	L. S. Haworth	Palmer & Haworth	Crooksville.

NOTE.—There are three other mines in this comnty, but the names are not known.

STARK COUNTY.

Fulton	Slope	Sam. Foultz	Fulton Coal Co	Canal Fulton.
Buckeye	"	Andy Harwick	Buckeye Coal Co	Canal Fulton.
Crawford	Shaft	Frank Millhoff	Crawford Coal Co	Massillon.
Crawford	Slope	Dan. Roderick	" "	Massillon.
Willow	"	Jas. Brown	Willow Bank Coal Co	Massillon.
Willow	Shaft	same	" "	Massillon.
Williamson	"	R. Donald	A. B. Williamson	Massillon.
Maple Grove	"	John Moore	Massillen Coal and Mining Co.	North Lawrence.
Aberdave	"	John Rosser	Youngstown Coal Co	Massillon.
Jacobs	"	Rinehart Keller	Rhodes Coal Co	Massillon.
Grove	"	H. D. Merryman	Grove Coal Co	Massillon.
Massillon Coal Co	"		Massillon Coal Co	Massillon.
Staoffer	Drift	S. Hands	J. P. Burton	Massillon.
Warrington	Shaft	Chas. Brenkard	Warrington Coal Co	Massillon.
Brookfield	"	H. Foultz	H. Foultz	Massillon.
Pigeon Run	"	Matthew English	Lee, Howell & Co	Massillon.
Lawrence	"	Andrew Praeter	J. P. Burton	Massillon.
Foultz's	Slope	Casper Hyman	Massillon City Coal Co	Massillon.

SUMMIT COUNTY.

Name of Mine.	Kind of mine.	Name of Manager.	Name of Coal Company.	P. O. address.
Crawford's	Drift	Frank Millhoft	Crawford & Co	Akron.
Franklin	Slope	I. Hoover	Franklin Coal Co	Akron.
Summit	"	Philip Reese	Summit Mine Coal Co	Akron.
Brewster Slope	"		Brewster Coal Co	Akron.
Brewster Drift	Drift		" "	Akron.
Brewster Bros	Slope	John H. Jones	Brewster Bros	Middlebury.
Middlebury Shaft	Shaft	John Beese	Middlebury Coal Co.	Middlebury.
Johnson Shaft	"	Mordecai Morris	Johnson Coal Co	Middlebury.
Dennison*	Drift		Dennison Coal Co	Sherman.
Nemisilla	Slope	George Smith	Nemisilla Coal Mining Co	Cleveland.
Norton's	"		Norton Coal Co	Sherman.

TUSCARAWAS COUNTY.

Black Vein*	Drift	Joseph Morris	Black Vein Colliery Co	Dennison.
Dennison*	"		Dennison Colliery Co	Dennison.
Andraes Mine	"	S. W. Andraes	S. W. Andraes & Co	Urichsville.
Stillwater	"	J. Fuller	Tuscarawas Valley Coal Co	N. Philadelphia.
Syracuse	"		Syracuse Coal Co	Urichsville.
Pike Run, No. 1	"	John Davis	Tuscarawas Valley Coal Co	N. Philadelphia.
Pike Run, No. 2	"	same	" " "	N. Philadelphia.
Rich Hill	Shaft	T. C. Snyder	Rich Hill Coal Co.	Waynesburgh.
Walton Ridge	Drift	Sam. Foultz	Buckeye Coal and Coke Co	N. Philadelphia.
Port Washington	"	Wm. Rennie	Glasgow and Port Washington Iron Co	Port Wash'gton.
Urichsville Shaft*	Shaft			

TRUMBULL COUNTY.

Vienna	Shaft	John Rosser	Vienna Coal and Iron Co	Youngstown.
Wheeler	Slope	Wm. Phillips	" " "	Youngstown.
Tyler	"	J. McIntosh	C. H. Andrew & Bro	Youngstown.
Halliday	"	Geo. Hornicle	Halliday Coal Co	Youngstown.
Hood	"	Thos. D. Phillips	Arms & Wick	Youngstown.
Sodom	"	Thos. J. Jones	McCurdy Coal Co.	Youngstown.
Church Hill Slope	"	Thomas Williams	Church Hill Coal Co.	Youngstown.
Church Hill Shaft	Shaft	Ben. Morris	Niles Coal Co	Youngstown.
Kline	Slope	William Parker	Brier Hill Iron Co.	Youngstown.
Moore*	"	Edward Powers	Moore Coal Co	Youngstown.
Shenango	"	Thos. Maxwell	Shenango Coal Co	Wheatland, Pa.
Brookfield	"	John Jones, 2d	Brookfield Coal Co	Sharon, Pa.
Burnett	"	G. Cramer	Burnett Coal Co.	Youngstown.
Jacobs ‡	Shaft	David Williams	Jacobs & Son	Youngstown.
Carbon Valley‡	Slope	Joseph Edwards	Wick, Struthers & Co.	Youngstown.
Stewart	"	Chas. Herbert	Mahoning Coal Co.	Youngstown.
Long Bank	"	same	" "	Youngstown.
Mahoning, No. 3	"	same	" "	Youngstown.
Chew	"	same	" "	Youngstown.
Cleveland	Shaft	T. Meredith	Payneheathen & Co	Cleveland.
Ashland	Slope	W. T. Williams	Ward, Warner & Co.	Mineral Ridge.
Weathersfield	Shaft	Thos. Morris	Wise Coal Co	Mineral Ridge.
Cambria	Slope	Wm. Edwards	Ward, Warner & Co	Mineral Ridge.
Love	"	Abner Lane	Andrews & Hitchcock	Youngstown.
Williams	Shaft	David Williams	D. Williams & Co.	Hubbard.
Winfield	Slope	C. H. Gilman	Winfield Coal Co.	Mineral Ridge.
Curtis Hill	Drift	Thos. Bailey	Curtis & Boyce	Sharon, Pa.

VINTON COUNTY.

Vinton	Shaft		Bancroft & Rader	Vinton Station.
Coalmont	Drift		Zaleski Coal Co	Zaleski.
Zaleski	"		" "	Zaleski.
Vinton	"		Vinton Coal and Iron Co	Vinton.
Moundville Mine	"		Richard Coe	Moundville.
Buckeye	"		Ingham Coal Co.	King's Switch.

WAYNE COUNTY.

Fairview	Shaft	Andrew Praeter	J. P. Burton	Massillon.
Crawford †	Drift	Frank Millhoff	Crawford, Scott & Co	Massillon.
Silver Creek, No. 1	"	Wm. Callin	Silver Creek Mining Co.	Doylestown.
Silver Creek, No. 2	Shaft	same	" "	Doylestown.

WASHINGTON COUNTY.

Washington*	Drift		Washington Coal Co	Youngstown.
Cliff Mines	"	G. W. Linn	G. W. Linn	Coal Run.
Macksburgh	"	A. Wyper	Ohio Coal Co	Marietta.

* Idle. † Drowned. ‡ Worked out.

THIRD ANNUAL REPORT

OF THE

STATE MINE INSPECTOR,

TO THE

GOVERNOR OF THE STATE OF OHIO,

FOR THE YEAR 1876.

COLUMBUS:
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ANNUAL REPORT.

Columbus, Ohio, *November* 14, 1876.

To His Excellency Rutherford B. Hayes, *Governor of Ohio:*

Sir: I have the honor to submit herewith my third annual report as State Mine Inspector, containing a description of the condition and operations of the coal mines of the State examined during the year; a sketch of the mining population, including suggestions for the amelioration of the condition of miners, and for the amicable adjustment of wages disputes between the miners and mine operators; and also some observations on the structure of the coal strata of the State.

In former reports I furnished a tabulated statement of the amount of coal mined in the various regions of the State, and made a comparison of the proportion of fatal accidents to the amount of coal raised. Owing to the recent act of the General Assembly changing the time of filing the report from the 31st of December to the 20th of November, I shall be unable to furnish the annual statement of the coal production of 1876. I may state here, however, that it will not exceed, if it will equal, 3,000,000 tons. This has been a year of unusual dullness in the coal trade, no one mining region working even half time.

Seventy serious accidents have been reported to date. In this number, two miners had their backs broken, two had each a leg cut off, and twenty-two had limbs (arms or legs) broken. The other accidents resulted in serious bruises, but no limbs were broken. The names of the unfortunate men and the cause of accident will be found at the end of the report.

Thirteen fatal accidents occurred, seven of which were caused by falls of roof, two from premature blasts, one from falling off the shutes outside, two from being crushed between cars, and one by the lowering of the cage at the bottom of the pit.

Only a very small per cent. of these accidents are reported by the officers of the mines. The law requires each mine superintendent to report promptly all accidents of a serious and fatal character, but there is no penalty attached for neglect or refusal to do so, and the bosses disregard the requirements of the law. The accidents, both serious and fatal, are mainly collected by myself, during official visits to the mines, and are furnished only on inquiry. All the accidents of a serious character may not be furnished, but those of a fatal character are, and the three years in which the law has been in operation show a marked diminution of fatalities. In 1874 thirty deaths occurred; in 1875, twenty-three, and this year the number is reduced to thirteen.

In the fall of 1875 legal proceedings were instituted against the Church Hill Coal Company, the Niles Coal Company, and the Halliday Coal Company, in Trumbull county, for neglect or refusal to comply with some of the provisions of the law. The cases were set for trial in February of the present year, but were continued, at my request, by reason of pending bills in the Legislature changing the mining law. These cases will be tried at the present term of court. During the summer I also sued the owers of the Hays Mine and the Empire Mine, because of the prevalence of defective ventilation. The only fault attaching to the Hays Mine was want of furnace power. Sufficient time was given to have a better furnace applied, but advantage was not taken of such time. The Empire Mine had neither furnace power nor proper ventilating arrangements inside. The matters complained of having been remedied, the suits were withdrawn, the mine-owners paying the costs of prosecution. Some other mines of this district yet require overhauling, and the owners will have themselves to blame if complaint is made against them in court.

STEUBENVILLE.

I commenced the annual tour of inspection on the 12th of January, visiting the Steubenville region of Jefferson county, and inspecting the Gravel shaft, the Bustard shaft, and the Rush Run shaft. The Gravel shaft had been in operation about twelve months, and had but one means of egress. The mine had good ventilation. The cages in the shafts were covered, safety-catches and safety-gates were applied, and a second opening was soon to be commenced.

The Bustard shaft had been sunk several years, but had been lying idle much of the time. It had recently started up again with a force of twelve men. There was only one opening to the mine, and I suggested the necessity for another in case the mine should continue working.

The Rush Run shaft had also but one opening. The force of men employed numbered eighteen, and I notified the superintendent that the force must be reduced to ten, as the law directs, until a second outlet were provided. This pit makes a good deal of fire-damp. It has, however, a double furnace at the bottom of the up-cast compartment, capable of giving motion to 20,000 cubic feet of air per minute.

On the 1st of March I again visited this region, inspecting the Boreland shaft, the Rolling Mill shaft, Everick's shaft, one division of the workings of the Market Street shaft, and visited the Gravel, the Bustard, and the Alikana shafts. At the Gravel shaft a second opening had been commenced, consisting of a circular shaft six feet in diameter. The site selected was an abandoned shaft, long filled up, from the interior of which two or three acres of coal had been excavated. This shaft was sunk into the excavated area and the water pumped out. In exploring the old workings, it was found that a "creep" in the floor had closed the rooms in many places, and it was decided to abandon the air-shaft and sink another nearer the main opening. This air-shaft was completed in the month of November.

During the summer a second opening was also sunk at the Bustard shaft, in accordance with the requirements of the mining law.

I have in former reports alluded to the superior ventilation prevailing in this region, surpassing any other district in the State. I have never received a single complaint of bad air, but all the miners have united in bearing willing testimony to the salubrious condition of the mines. Entries and rooms alike are well and thoroughly aired, and the moving columns of wind are strong and vigorous. There are no strikes in this region; there is no fault-finding with the bosses. Many mine-owners and bosses in other regions curse and traduce their miners for their chronic spirit of grumbling and complaining; but when the interior of their mines are examined it is no wonder miners grumble and complain. In many of the working places a light will scarcely burn, and the miners are enveloped in thick and suffocating clouds of smoke. Such mine-owners and their bosses, to a man, can see no necessity for a mining law, and regard it as an unwarranted interference with their business.

The Market Street Mine, one of the oldest of the series of shaft openings, has been worked continuously since the pit was sunk. The Stony Hollow pit is sunk at the advance workings on the north said of the old pit, and the two shafts form one colliery, the entries being ten feet wide, the rooms eighteen feet wide, the pillars twenty-four feet thick by seventy-five feet long. If gas appears in the heads of the rooms before the seventy-five-foot pillar is won, an air-crossing is cut, so that there is not always regularity as to the length of the pillars.

There are five stations in the mine, three on the north side, and two on the south side. In these stations, owing to the thinness of the seam, the hauling mules can not enter the rooms, and the cars, which hold twelve bushels each, are pushed out to the hauling-roads by "putters," three putters being usually employed in a station of fourteen or fifteen rooms. The stations where the mules haul from are located as near the center room as practicable, being generally from three to four pillars behind the working faces. These centers are moved forward as the workings advance. By this arrangement the putting roads are made shorter, and have equal men on each side of the mule road.

Some years ago a panel or square of work was laid on the long-wall system, all the coal being cut away as the workings advanced forward, after the usual practice in long-wall mining, but the result was deemed unsatisfactory and the practice was abandoned.

There is an abundant ventilation prevailing in every division of the mine, the amount of air in circulation reaching 50,000 cubic feet per minute. The air is split at the bottom of the shaft into two nearly equal parts, one split going north and the other south. The south split is again split into two parts a short distance from the bottom of the shaft, one-half going east. Six hundred feet ahead the eastern split is again divided, the northern division ventilating the "east arm" on the north side of the pit; thence it passes to the Stony Hollow pit, traversing a series of rooms there, and returns to the up-cast. The south part of the east split travels south, ventilating a series of rooms, then uniting with the part it split from, airs the workings on the south-west, then moves north to the pillar workings, passing which it returns to the up-cast at the old pit furnace.

The northern column of air, which splits at the bottom of the down-cast, goes north, as stated above, and ventilates what is known as the Cherry Station of workings, then passes to the south rooms of the Stony Hollow pit, and returns to the furnance, uniting with the column which splits off to the north six hundred feet from the bottom of the down-cast shaft.

The notes taken as to the condition and manner of working the mines of this region, during the tour of inspection, were lost, and the account of the plans of ventilation in practice in the Market Street and Stony Hollow shafts was furnished by William Smurthwaithe, the underground manager, by request from me.

The plan of working and ventilation is, however, the same throughout the district, each mine differing only in details. In the Rolling Mill shaft, the Everick shaft, and in Boreland's, the pits are divided into up-cast and down-cast compartments, the furnace being placed at the bottom of the up-cast compartment. Everick's shaft, at the date of inspection, was evolving a large quantity of fire-damp in the interior workings. The gas was so strong that the vigorous moving current of air passing along the air-course had to be brought forward and made to play against the wall faces where the miners were at work to prevent its accumulation; and it exploded in the naked light as it evolved from the coal strata. Some of the miners said that few working places in the mines in England ever discharged a greater volume of gas than the division of this mine where this gas was given off.

SALINEVILLE REGION.

The mines of the Salineville district, as stated in former reports, are opened on two seams of coal known as the Big Vein and the Strip Vein. The mines opened in the Big Vein are located on the north branch of Yellow Creek, in and around the village of Salineville. The coal ranges from three to six feet in thickness where mined. John Hays's mine, the lowest opening on the creek, is two mile south-east of Salineville, on the line of the Cleveland and Pittsburgh Railroad. The coal is thinner in this mine than in any other opened on the same bed of the district, seldom exceeding three and a half feet. The mine is opened on a plateau or ridge of the strata, and to this circumstance is due its decreased height.

The mine is level-free. The right butt entry is driven through the hill, and this outlet is used as an intake air-way. Near the mouth of the main opening a shallow air-shaft has been sunk, at the bottom of which a rude furnace was placed. At the mouth of the mine a trap-door is hung to prevent the air from coming in at this opening and passing through the air-shaft. I suggested to the mine boss to take out the present furnace, and rebuild a large and properly constructed one in its stead. The furnace in use was no larger than an ordinary grate, and served little or no purpose whatever. The system of laying out the workings is the one prevailing in the Strip Vein mines; the butt entries are all single, and driven eighty yards apart, and rooms worked from both sides—the rooms which go to the dip of the coal advancing thirty yards, and those which follow the rise of the coal advancing fifty yards, when they meet. The rooms are made seven yards wide, and pillars of about three yards in thickness left between them. Owing to the thinness of the coal, it would be a costly undertaking to drive double entries and cut down two feet of roof for hauling-roads; but with the small force of men usually employed, if proper care and skill are exercised, and an abundant column of air kept flowing along the galleries, the ventilation can be kept above complaint.

Robertsville Mine, operated by J. C. Brown & Co., is opened on the Strip Vein. The main entry, which follows the face of the coal, runs north 22° east. There are two butt entries in operation—one on each side of the main entry. These galleries are each eight feet wide, and are single, in accordance with the prevailing practice of the region. The rooms are made twenty-one feet wide, but are broken off the entry only eleven feet wide, being opened out to twenty-one feet after advancing four yards. The thickness of pillar between the rooms is nine feet, and is cut through every ten or twelve yards. The former practice was to open rooms on both sides of the butt entry, but this plan has been abandoned, and now rooms work only to the north. These room entries are made fifty-two yards apart, and they follow each other in *eschelon*, the first rooms of the first entry being worked up and cut through at their heads by the second entry, and so on. This arrangement allows the air to flow to the face of the butt entries, and saves the trouble of driving air-courses. The pillars of the mine are left standing, never to be recovered.

The air of this mine was not good. The miners blast at all hours of the day, and load the sluggish atmosphere of the mine with powder smoke. Mr. Brown, the manager, promised to sink an air-shaft, to come down near the face of the main entry, and put a furnace there. When this is done, there will be such a current as the law requires.

The Big Vein mine, operated by this company, is known as the Brown Mine. The main entry runs southward on the face of the coal. There are two butt entries in operation, Nos. 4 and 5. The main part of the workings is in No. 4. The rooms are made twenty-four feet wide—opened on one side of the entry only. The pillars are eight feet thick. This mine runs through the hill, and has a shallow air-shaft in addtion. The ventilation is by furnace power, the air coming in from the outlet through the hill, and, after passing along the entry where the people are employed, is discharged at the furnace shaft. This mine and that of Roberts's were inspected for the first time during the summer, being idle on former visits.

In addition to these two mines, several other openings are made on the mineral property of this coal company; but they are not in operation, and so have not been examined.

The Farmer Mine is carefully laid off; and though relying for ventilation on the natural forces alone, is well ventilated. It has three openings—the main entrance, a water outlet, and a slope. The main gallery is seven hundred yards long, and follows the face of the coal, running about 22° west of south. On each side of this entry an air-course extends along the eastern and western boundary of the coal property. Butt entries are placed every sixty yards, the rooms working to the south only. The rooms are twenty-one feet wide, but are broken off at seventeen feet; the thickness of pillar between rooms is nine feet. One butt entry on each side is worked forward to the line, and its lift of rooms opened and worked well forward before the newer entries are started. By this arrangement the new entries cut through on the rooms as they are being finished up, and bring the air forward toward the face. The rooms are not full width in going through in the advancing entry, but are made narrow to add strength to the mine, and only every alternate room is holed. As newer holings are made on the entry, the older ones are boarded up. The entry pillar is forty feet thick.

There have been thirteen lifts or ranges of workings on the east of the main entry, and eleven on the west. The air flows in at the main entrance of the mine in winter, and at the slope mouth in summer, and passes along the butt entries, where the miners are at work. Every advantage is taken of the natural condition, and every thing is done properly and in order. This is one of very few mines in the State where, relying on the natural forces alone, the ventilation has been above complaint, and this result is due to the skill and judgment of the mining boss, Mr. Sampson Sharpe.

The two mines of the Ohio and Pennsylvania Coal Company, the Hays Mine and Jones Mine, both opened within two hundred yards of each other, have undergone marked improvement in their ventilating arrangements. Along the line of the face entry of the Hays Mine, six hundred yards from its mouth, a roomy air-shaft has been sunk, and a large and finely constructed furnace has been erected. The air-shaft is eighty feet deep. The furnace is five feet wide and five feet high above the bars, and causes a powerful draft of air. The miners are now forbidden from firing during working hours, an arrangement with which the majority of them are well satisfied. There are now no longer complaints of bad air in these mines.

The Empire Mine is one-fourth of a mile north-west of John Hays's, and is opened on the same seam of coal. The difference in level of the mouths of these two openings is fully fifty feet. This is caused by the Hays Mine occupying a plateau of the strata, as already alluded to, and the Empire Mine the low ground or swamp. In the east entry of the Empire, following the butts of the coal, the rise is equal to five feet to the hundred feet. All the workings extending south-east dip under water into the swam p, and a number of rooms were submerged at the time the mine was inspected; but in crossing this swamp the strata rise southward. The coal is from four and a half to five and a half feet high, but south-eastward in approaching the Hays Mine it loses in height as it ascends the hillside.

The face entry of this mine is south 22° west. One butt entry is opened to the east and three to the west of the main gallery. The entries are all single, and the mine has been worked without much regard to the ventilating arrangements. The current of air was very feeble, owing its motion to the natural forces. There is a shallow air-shaft sunk near the mouth of the main entrance, but it was not in use, because it was of little or no use, and the return air was discharged at a drift opening, reaching day from the first eastern butt entry. The mine had changed hands some time before my visit in May last, and is now operated by the Ohio and Pennsylvania Company. This firm had in contemplation the sinking of an air-shaft at a suitable place, which, when completed, and a proper ventilating furnace erected, will give necessary motion to the air. Formerly the miners blasted at all hours of the day, but now the use of powder is forbidden until four o'clock in the evening, and the mine is kept clean of powder and smoke during working hours.

I again visited this mine in July, and found that no air-shaft had been sunk, and that the air was still very bad. I tried to calculate the amount of air in circulation, but could perceive no motion whatever, except what was made by the action of the mine-cars. The doors of the mine were badly hung, and were out of order; the stoppings were also leaky, and the miners generally, and justly, complained of the foul condition of the mine. And this had been its condition since it was first opened.

The first visit to the John Hays Mine occurred in the early part of May. On the occasion of the last visit to Salineville, in July, I inspected the mine again, a force of twenty-six men being at work. There had been no change in the ventilating furnace, and in passing through the mine I found the air loaded with powder-smoke. The arrangements for carrying the circulating current round the workings were, however, very good, the main fault lying in want of power to give motion to the air. The doors were well hung, and the stoppings secure, but the furnace was wholly inadequate for the work required.

On the occasion of this visit to the Salineville district, complaint was made in court against the John Hays and Empire mines for having defective ventilation. A new and improved furnace was built at the Hays Mine; an air-shaft was sunk and furnace built at the Empire, and the ventilation improved in both mines, satisfying the requirements of the law. Legal proceedings were discontinued as soon as these improvements were made, the coal companies paying the costs of the suit. There are several other mines in this district which will be complained against if improvement is not made.

CAMBRIDGE MINES.

There are but five mines in this county which come under the provisions of the mining law, one shaft and four drift mines. The shaft is the most easterly of the series of mines, and is situate five miles east of Cambridge, on the line of the Baltimore and Ohio Railroad. It is sunk at the foot of a high bluff, and the pit itself is but thirty-three feet deep, while the cover over the coal is fully two hundred feet in the hill. The main entry runs north on the face of the coal. Three butt entries are working, the lower two are each double, a pillar of fifteen feet in thickness being left between each gallery, which is cut through every fifty yards for air. Rooms are opened on the lower butt entry to the north and south, but on the middle ones, as also on No. 3, or the furnace entry, rooms are turned to the north only. The rooms are worked up one hundred and thirteen feet. The pillars left are twenty feet in thickness, and the rooms are twenty feet wide. No break-throughs or cross-cuts are made from one room to another.

The ventilation was good throughout the mine. Only a small force of men were employed, and none of them were in rooms far advanced in the fast. The stoppings along the entries were built of refuse matter from the entries and rooms. This material needs frequent overhauling, as, no matter how closely it may be packed, it soon settles down, and allows the air to leak and spill at the roof.

The ventilation was due to furnace-power. The air-shaft is ninety-one feet deep, is sunk on entry No. 3, or the third lift of butt entries, and is dry and roomy.

In working up rooms one hundred yards, without openings or break-throughs from one to the other, too great an advance is made in the fast for the sanitary requirements of the mine. With a vigorous current of air playing along the entries, a small force of men in the mine, and little or no powder used during working hours, there may be no cause for complaint; but where the force of the mine is large, and a free use of powder made during working hours, or even in the evening, as the miners leave the mine, there can not, by this arrangement, be good air. These words are not uttered as reflecting on the present condition of this mine. There was no cause of complaint. Every thing betokened care and prudence, and if the underground force is not increased, and the sanitary arrangements continue to be equally well maintained, the mine will be well ventilated for years to come.

Scott's mine, situate one mile west of the shaft, is opened on the face of the coal, the main entry angling a few degrees to the west across the face until it has been advanced one thousand feet, when it follows the plane on a true line. All the workings are opened west of the main entry, and consist of five branch or butt entries, each about one hundred yards apart, rooms being opened from both sides of these entries. The rooms in the first two entries have been finished up, but the pillars are left standing. Between the third and fourth entries no rooms have been opened, and this square has been divided up into a number of blocks by driving face entries eighty yards apart through the solid coal. Rooms are then started on the butts of the coal from both sides of the face entries. The workmen seem to regard these butt-rooms as of no advantage over those advancing on the face of the coal, though they can do equally well in them as in face-rooms. This is the only place in the district where an experiment has been made by opening rooms on the butts, and now that no extra cost is thereby occasioned it will doubtless be more generally applied.

All the older workings of this mine were laid out with the object of finishing up the mine in the first stage of working, and leaving the pillars standing behind. To recover as much coal as possible in working forward, the rooms were made seven and eight yards wide, and the pillars only eight and nine feet thick. The floor of the coal, a soft and yielding fire-clay, gave way before the mine was more than well opened out, producing a creep of the workings, the pillars sinking into the floor, and closing up the mine. Larger pillars are now left to hold the mine firm until the domain sought to be wrought over has been won. The pillars will then be attacked, and as many of them recovered as possible. This system can be improved, and all the coal recovered in working forward, by laying the workings out in blocks or panels, guarding the hauling-roads with strong pillars, and working out the pillars as soon as the rooms are worked up. The manager has this plan under consideration. He can apply it successfully and recover fully ninety per cent. of all the coal of the mine. Since the mines of this district were opened a ton of coal has been lost for every ton recovered. The mine is ventilated by means of an air-shaft sunk at the end of the first butt entry, at the bottom of which there is a good furnace. This part of the mine is protected by a strong pillar of coal one hundred feet thick. The air is received at the main entrance, passes to the head of the face entry, which is now a double entry, with a twenty-five-foot pillar between these parallel headings; thence it flows along the inmost butt entry, and passes through a face air-course to the fourth face-gallery, cut through the solid block of coal, to open rooms on the butts; thence it passes through an air-course on the east flank of the one-hundred-foot pillar which supports the air-shaft, and finally reaching the furnace is discharged through the up-cast. This plan of ventilation is one very generally in use in the State, and can not be commended. There can never be good air in the rooms and entries ahead of the air-course. Before the last air-course is through the newer workings are again in the face. Double entries, main and butt alike, ever kept abreast, alone can satisfy the requirements of the mining law, and maintain all the ramifications of the mine in a fit state for men to work.

The Guernsey Mine is one-third of a mile west of the Cambridge Mine. The mouth of the drift is forty feet higher than the railroad, and twenty-five feet higher than the opening of the Cambridge Mine. An inclined plane, three hundred and fifty feet in length, and rising one foot in five, extends from the dump to the drift-mouth. The main entry follows the face of the coal south. The entry rises from its entrance for a distance of six hundred feet, and at this point is ten to twelve feet higher than the mouth of the mine; then the coal floor flattens to a level or takes a slight reverse dip. This entry has been in an immense horseback for six hundred feet, and is not yet through it. The light slate roof is supplanted by a roof of sandstone, which also cuts away part of the coal seam, until at many points in the entry not more than a foot or fifteen inches of coal is left. The rock roof is very irregular, causing the coal to increase and diminish in height at short intervals.

To the west of the main entry all the available coal of this mining property is worked out, and that part of the mine has been abandoned. The workings are east of the main gallery, and are opened in the butt entries. An air entry is opened one hundred and fifty yards east of the main opening, which receives the intake current. These entries are all single, the rooms are twenty feet wide, the pillars sixteen feet thick, and no break-throughs are made between the rooms. The up-cast shaft consists of a wooden box erected to the west of the main entrance; on the outside of the mine a small and rude furnace is placed near the bottom of this box, and this fire gives a feeble motion to the air. The stone entry is aired by means of a wooden box laid on one side of the gallery, which receives air from the main air entry. Nearly all motion is lost to the current, and the face of the entry has not an inviting atmosphere. All the ventilating arrangements of this mine are feeble and temporary. Owing to the long duration of the fault in the main gallery, no encouragement has been offered to construct more costly and elaborate structures. A good air-shaft, a substantial furnace or an exhaust fan, roomy air-courses, and double entries alone can give motion to air and preserve the current pure and sweet at the wall faces, where it is needed.

The Cambridge mines were idle when this district was visited, and the mine was not examined. It usually employs a large force of m
and the workings are quite extensive.

The Nicholson Mine is situate on the Marietta, Pittsburgh and land Railroad, two miles south of Cambridge. The coal is level free, and is reached by a drift opening. The mine is ventilated by a furnace placed at the bottom of a shallow air-shaft which is sunk to the south of the main opening. The main entry following the face of the coal is double, but the butt entries are single, air-courses being driven in the fast from one butt entry to the other every one hundred yards. This plan is now being abandoned and double butt entries laid out instead. A pillar of twenty-five feet in thickness is left between the parallel entries, which is pierced through every forty-five yards for air. The rooms are worked twenty feet wide, with pillars eight and ten feet in thickness left between them. This width of pillar is too weak to leave standing for any length of time, or even for recovery immediately after the rooms are worked up.

At the date of inspection, the mine was paying the penalty of weak pillars in a crush of the overlying rocks, which broke over the abandoned rooms into the entry and ruined a valuable part of the mine. The hill was rent to the surface.

I suggested to Mr. Granger, the manager of the mine, to make the pillars at least double the width they are now made; to work the mine in panels or squares; to increase the distance between the butt entries to two hundred yards, and to attack the pillars of each panel after the rooms are worked out, and cut all the pillar coal away, allowing the exhausted area to crush and fall to the surface. By this plan nearly all the pillar coal could be recovered, and the possibility of a general crush or creep extending over the mine be prevented.

The first break occasioned by the crushing of the pillars came to the surface and encouraged the mine boss to hope that the squeeze had exhausted itself, and my suggestion to erect a series of wooden pillars along the line of the break was disregarded. A few months afterward the mine crushed anew, and many times the cost which would have sufficed to have erected all necessary safeguards against such a contingency were involved in the crush.

LEETONIA.

The Cherry Valley Iron Company have three mines two drift and one slope. They are opened on Green Creek, the two drifts at Washingtonville and the slope at Leetonia. The slope is eighty-five feet in length, and eleven feet wide the whole way down, affording ample passage for the miners without traveling on the track. The coal is quite thin, never exceeding three feet, and averaging less than thirty inches. The main entry runs west, is five hundred yards in length, and has reached the line of the coal property. This entry is fourteen feet wide for nearly its whole length, and has a double track. There are fifteen butt entries, eight on the north side and seven on the south side of the main entry. The face-slips of the coal run N. 45° E., and the butt-slips N. 45° W. The butt entries are each one hundred yards apart, and have been extended five hundred yards or more. Each entry is seven feet wide and five feet high above the rail; the rooms are broken off seven feet wide, extended to twenty feet, with pillars of ten feet between the rooms—the pillars being taken out after the mines are finished. Only the height of coal is taken forward in the rooms, and the miners have to crawl on all fours to reach their working places after leaving the entry.

The Roller and Washingtonville mines of this company are level free, and are holed through on each other. The Washingtonville has an air opening fronting Green Creek, and the ventilation is by the natural forces—the air sometimes entering and sometimes discharging itself through this entry, according to the force and direction of the wind, the motion of the cars, or the difference in density of the mine and outside temperature. The system of working and of ventilation is the same at all the mines of this company. There are thirteen butt entries in the Washingtonville mine, seven to the south-east and six to the north west of the face entry. The butt entries of this mine extend eight hundred and nine hundred yards on each side of the main gallery. The Roller mine is less extensive, having five butt entries on one side and four on the other side of the main gallery. The north-western entries extend to the boundary; those on the opposite side meeting with the workings of the Washingtonville mine.

The plan of ventilation consists in driving air-courses alongside of the way entry, leaving a pillar twelve feet thick between the air-way and the gallery. The rooms are laid out in a series of ten to each block or square, are worked on both sides of the butt entry, and meet in the middle after advancing fifty yards. The ten rooms on the side opposite the air-course are worked first, and after they are finished the ten rooms on the air-course side are started. An air-course, consisting of the inmost of the ten rooms, is cut to the adjoining entry, so that the air is made to play past every room. Meantime the entry continues working ahead. To get the air up to it, temporary brattice is built between the entry and the air-course openings, except the last opening inside of the block, and this forces the air up towards the entry face, the current returning down the air-way to the room air-course that goes through on the adjoining entry. The ventilating currents are not as strong as they ought to be, mainly for want of furnace power; but as the miners knock all the coal and use no gunpowder in the mines, except in blasting roof and bottom on the entries, less air will suffice for ventilation than in mines where blasting is done in every working place.

There are numerous depressions and hills in the mines, and in driving forward the entries, the height for the hauling roads are taken out of the roof or bottom, like the cuts and fills of a railroad. When hills seven or eight feet in height are encountered, the entry is made level by cutting out the bottom. Sometimes dips are encountered, the water of which can be drained by abandoning this part of the mine until a passage-way is cut in the coal along the line of depression or swamp. Last spring, in one of these dips in the Grant and Davis entries, five acres of water were pent up, and a gallery was driven in the swamp from the Shoo-fly entry to tap it. Before reaching the water, bore-holes were hept in advance of the miners, and the water was tapped and liberated without accident.

Walter's Mine, of Walters & Co., is a drift opening, situate three-quarters of a mile north-east of the Washingtonville Mine of the Cherry Valley Iron Company. This mine was opened in 1873 by the New Lisbon Coal Company, and laid out on the "long-wall" system. Only a few months' work was done, when the mine stopped and the company abandoned the lease. It lay idle eighteen months, and was reopened by Walters & Street. They at once abandoned the long-wall practice and adopted pillar and room, following the method in practice in the mines of the neighborhood. Little work had been done at the date of inspection, in August.

The Grafton Iron Company's mine, situate at Leetonia, is a shaft ninety-five feet deep. It is sunk through two different beds of coal, the lower bed being fifty feet below the upper one. The lower coal is not wrought at present. The upper coal is the equivalent of the seam mined at Washingtonville by the Cherry Valley Iron Company and by other firms in this district. The coal is twenty-eight inches in thickness on the average, locally rising to thirty-two inches, but only the lower twenty inches is taken out of the mine. The main entry, called the Craig Entry, runs N. 40° W., angling across the face of the coal. This entry is two thousand feet in length, and has dipped nine feet in this distance.

The entries of the mine are seven feet wide and five feet high above the rail. The rooms are six feet wide when broken off, but are widened out to eighteen feet, leaving pillars of four feet in thickness between the rooms. As the top coal, eight inches thick, is stowed back in the rooms, the goaves are well filled up, and any falls or crushes that occur confine themselves to abandoned rooms, and never overrun the entries.

There is an air-shaft and furnace for ventilation, the hoisting-shaft being the down-cast. An air-course is driven alongside of the main entry, but the butt entries, which are one hundred yards apart, are ventilated by air-courses driven from one to the other every one hundred yards. This forms a series of blocks one hundred yards square, twelve rooms being in each block.

The floor of the mines of this district is damp, sometimes wet, and the miners, passing all their working time sitting or stretched on the pavement, contract rheumatism and lumbago in consequence. When cars are plenty and work steady, four to five per cent. of the underground forces are laid up by disease contracted in the mine. None of the working places are more than thirty-two inches high, and many of them are less than twenty-six inches, the general average being twenty-eight inches. To reach their working places from the entries the men are required to crawl on all fours, and when they want to rest they must stretch themselves out on the ground. In other respects the mines are safe; low workings are always safer from falling materials in the roof than high ones. Loose material is more readily detected, and when it falls it does not hurt so badly. Accidents from falls of roof or of coal are, therefore, seldom reported in this district.

BARNESVILLE.

All the mines in Belmont county are opened in the equivalent of the Pittsburgh Coal No. 8 of the Geological Survey. The Barnesville Coal Works, situate at Barnesville, on the Baltimore and Ohio Railroad, is a shaft mine one hundred and eighty-six feet of perpendicular depth. This shaft was sunk in the summer of 1874 to a depth of eighty-seven feet to an upper seam of coal five feet in height. The coal proved to be of an inferior quality, and after running the mine for a few months, the proprietors resolved on sinking down to the Pittsburgh bed. The shaft, which was originally of one compartment, circular in form, and of a diameter of six feet, was made rectangular and enlarged to eight feet wide by sixteen feet in length. The coal is from four to five feet in height. The workings have not advanced any distance from the bottom of the shaft, but as far as they have gone have been laid off with due care and skill. A substantial furnace has been erected at the bottom of the up-cast compartment of the shaft, the cages are covered, safety-gates applied, but the safety-catches have not yet been put on the cages. The mine makes a little fire-damp.

Though this shaft is one hundred and eighty-six feet deep, and passes through three seams of coal, it makes no water, except a very small quantity in the limestone and cement rocks near the top of the shaft.

BELLAIR MINES.

The mines of Stewart & Meehan and those of Kidd Brothers are also opened on the line of the Baltimore and Ohio Railroad. Both are drift openings. Stewart & Meehan's is situate at Franklin Station, seven miles west of Bellair. The mine is opened on the butts of the coal, and as it enters the hill a face entry is pushed forward to the boundary of the property and an air-shaft sunk there, at the bottom of which a ventilating furnace is placed. The main butt entry consists of three parallel entries, separated from each other by pillars of thirty feet in thickness. The rooms are started on the left of the left flank entry, and on the right of the right flank; one, the central gallery, being kept for a permanent hauling-road and air-course. Air-passages are cut through from one entry to another every one hundred feet, and as the newer ones are made the older ones are closed, in order to discharge the air at the wall-faces, where the people are employed. From the main face entry another butt entry is worked forward, being divided from the main butt entry by a block one hundred and twenty yards in thickness. Rooms are worked to the right and left of this entry, the left rooms meeting the right rooms of the right flank entry.

In opening this mine the coal raised along the main gallery for several hundred feet, then started off on its regular level. The top of the hill was thirteen feet higher than the mouth of the mine, and the mine mouth was about the same depth below the dump. This made very unsatisfactory conditions, and last summer the mine-owners opened an entry above the coal, running in level, to cut off the hill in the mine and the hill outside, but on encountering the limestone, thirteen feet above the coal, the cost of cutting through it proved so great that they were obliged to start a new and lower level, and run in under the limestone.

Kidd's Mine, situate at Neff's Siding, consists of two openings, two hundred yards apart. The old opening runs north on the face of the coal, and two hundred and fifty yards from its entrance crosses a dike, which throws the coal down upwards of three feet. For one hundred yards inside of this dike the coal dipped into a swamp and then commenced rising. It also dipped from the entrance of the mine to the dike, the swamp being eighteen feet lower than the mine mouth. The new opening was made to cut off the up-hill grade, and was commenced fifteen feet below the coal. This opening ran north-west and struck the dike one hundred yards from its mouth, the line of direction of the dike being north-east.

A few yards inside of the dike this entry was changed in a north-eastern course, running parallel with the down-throw. There are two butt entries in these rooms, one started from off the old main entry and the other from off the new. They both run west, and the entry extending from the old opening crosses the dike, where the down-throw is seven feet deep. The second butt entry, beginning west of the dike, does not intercept it. Both of these galleries run out to day and give the working places of the miners excellent ventilation.

The rooms are worked twenty-four feet wide, the pillars are six feet thick, the butt entries are eighty yards apart, and the rooms work to the north. All the hauling is done from the new mine.

The entries of this mine, as well as of the Franklin Mine, do not exceed six feet in width, and this is the prevailing condition all over the Bellair district. There is a friable material, one to one and a half feet thick, called soapstone by the miners, immediately above the coal, which forbids wide entry workings, and when it falls down the upper bench of coal, resting upon it, also gives way and falls.

The Belmont Works, situate immediately below Bellair, consist of two drift mines, which are the lowest openings on the Ohio River, in the Bellair region, where the Pittsburgh coal is accessible by drifting. The main gallery of the upper mine runs through the hill. This entry is twenty-one hundred yards in length. It enters the hill and runs quartering on the butts of the coal for fifteen hundred yards, then wheels to the west, were it comes out to day. One thousand yards from the mouth of the main entry a face entry is driven to the south, and heads through at the face of the workings in the lower mine, the distance being three hundred and twenty yards. Five hundred yards inside of this entry another face, also running south, is driven four hundred yards. From this entry four butt entries are driven to the west, each entry being one hundred yards apart. The rooms are opened in these entries, and worked to the south; they are twenty-four feet wide, with ten-foot pillars between them. All coal north of the main gallery is solid, no workings extending in that direction.

The lower mine is seven hundred yards below the upper one, and enters the hill on the same line, but after the main entry extends three hundred yards its line of direction is changed to the butts, so that the main entries of each mine gradually approach each other. The face entries of this mine run to the north, the butt entries running west. The rooms also run north, so that the rooms of the upper mine and those of the lower one face each other.

Both mines are ventilated by furnace power. In the upper mine the air is received from the gallery through the hill, and passes along this entry till the inmost face entry is reached, when it is sent down to ventilate that line of workings; thence it passes along the inmost butt entry to the next face entry, ventilating that division of the workings, and so on till all the working galleries have been passed. The current then returns to the main entry and passes along it to the furnace at the air-shaft, near the mouth of the mine. In the new mine the circulating current of air enters at the mine mouth, passes through the working places, and returns by a return air-course to the furnace. Excellent ventilation prevails through every working place—room and entry alike—in both mines. The miners boast of the salubrious condition of their working places, and speak of their employer with respect and gratitude. There is no grumbling and fault-finding with the mine and its management, as is so often seen where bad ventilation prevails.

The Pittsburgh Works of Rockenhauser and Sterrit, one mile below Bellair, on the Ohio River, have been greatly improved in their sanitary condition within the past year. An air-shaft eighty-six feet in depth has been sunk at the back of the main entry. In extending the main entry from this point, three parallel entries are driven abreast, one for a permanent hauling-gallery, one for a permanent air-course, and the third for opening up rooms. The rooms are broken off the entry full width. Formerly, when only two entries were made, the rooms were opened in narrow necks until they had advanced twenty feet, when they were widened out to twenty five feet. By driving three entries these narrow necks are dispensed with, the cost of cutting which equals the extra cost of cutting an additional gallery. To impart extra strength to this part of the mine, the pillar of coal between the main and air-entries is made forty feet thick, and a fifty-foot pillar stands between the air-gallery and the main hauling-gallery. In the other divisions of the mine the butt entries are double, one for air and the other for rooms. The rooms are broken twenty feet wide, and are opened to twenty-five feet. At every eighth room a pillar of sixty feet in thickness is left, the pillars between the rooms in other cases being from fourteen to fifteen feet. After the rooms of a square have been worked up, the sixty-foot pillar is sometimes, but not always, split by driving a room up through the middle of it.

In working by this plan all the pillar coal is lost, and no thought is given to its future recovery. Indeed, its recovery may be said to be impossible, either immediately or remotely, under the present system of working. Stronger pillars must be left between the rooms, and the mine worked in panels, so that when the pillars are removed the crush which follows will confine its force to the ground exhausted, and afterward be powerless for mischief. By the sacrifice of all pillar coal, as the mines of the Bellair region are now worked, fully one-half of the coal, exclusive of slack made in mining, is hopelessly sacrificed.

The Weegee Slope, one of the oldest mines in the Bellair district, has been running for twenty-five years. The main entry goes north on the face of the coal, but the butt entries, running west, angle a little, the dip of the coal being more marked in this mine than any other of the district, exceeding sixty feet to the mile. The butt entries extend westward, and are eighty yards apart. The rooms are twenty-five feet wide, the pillars ten feet thick. The ventilation is by furnace power, the air entering the slope and passing along the workings, thence returning by a return air-course to the furnace at the bottom of the up-cast shaft.

The mine first below Weegee, the Empire Slope, has not been running since the mining law went into operation. The workings are full of water to the slope's mouth. Two efforts have been made by the owners to drain the mine and resume operations within the past year. The mine is favorably situated on the river bank, and the slope is not deep.

The Union Coal Works consist of a slope four hundred and twenty-eight feet in length, dipping thirteen inches to the yard. The slope passes through limestone most of the way, a hard and difficult material through which to cut a true grade; but the grade is regular and true, and the slope from the top to the bottom is one of the finest pieces of engineering skill ever completed in the State.

During the summer the structures at the top of the slope were destroyed by fire, but they have since been replaced by improved machinery. The bottom of the slope has also been improved by taking out all the old timbering and replacing it with newer and higher structures, adding comfort and safety to the mine. The system of working is also being changed, so that all entries will be double in the future.

The ventilation in this slope is good; there is a powerful column of air flowing down the slope when the furnace is kept up, and there can be no complaint as to ventilation, unless the arrangements for distributing the current are neglected in the interior of the mine. The ventilating furnace is roomy, well constructed, and safe.

The Pipe Creek mines are the lowest works in the Bellair district. The main opening consists of a slope seventy yards in length, dipping one foot in three. The main entry runs north on the face of the coal. The workings are all west of the face entry, and consist of three butt entries, each one hundred yards apart, from which the rooms extend northward. The rooms are twenty-four feet wide, with twelve-foot pillars. The first butt entry is double, with a thirty-foot pillar between the parallels. The second one is single, but the third is double, the pillar between the parellels being fifty feet thick.

When this mine was opened it was laid out with skill and judgment, but later the workings were neglected, or were placed in charge of parties without practical knowledge or experience. The pillars were reduced to six feet, and the rooms widened to twenty-seven and thirty feet. The result was, a crush occurred, overrunning the first butt entry and extending to the second. It was, however, arrested, and the system of working changed by Mr. James Lashley, the foreman of the mine. The third butt entry, as stated, was made double, with fifty feet of pillar between the entries, and the rooms from the second lift were stopped fifty feet from the lower parallel. In extending the first and second butt entries also strong pillars one hundred to one hundred and fifty feet thick were left between every ten or twelve rooms. Only a small force of men is usually employed.

MACKSBURG MINES.

On the 30th and 31st of March the Macksburg mines, located in the southern part of Noble county, on the line of the Marietta, Pittsburgh and Cleveland Railroad, were visited and inspected. These mines are opened on the equivalent of the Pittsburgh coal, which here, as at so many other localities in Ohio and Pennsylvania, forms a double seam. The lower bench is from five to six feet in thickness, of good quality, and a homogeneous mass. The upper bench is from two inches to three feet thick, and is separated from the main seam by a band of fire-clay or soapstone of varying thickness, but usually about three feet. The upper bench is of no commercial value, being largely impregnated with sulphur and other impurities, and it is left untouched in the mines.

This seam of coal at Macksburg lies high up in the bluffs, and has a light cover—less than one hundred feet. The numerous ravines of the neighborhood cut down through the coal at many points, so that in opening the mines the main galleries can be pushed through the hills to day. The rooms are made twenty-one feet wide, with pillars of ten feet between each room. The butt entries are one hundred and twenty yards apart, and rooms are worked off each side of the entry. As soon as the opposing rooms are cut through on each other, the pillars are attacked and withdrawn. Five pillars are simultaneously robbed, and after being finished up five others are attacked, and so on until the whole series are won.

The band of light shale which lies between the two coals is soft and fragile, and requires thickly-set props to maintain it in place. A saving would be had on prop-wood, and more lump coal would be made, by working these mines on the long-wall system; but it is doubtful if the expense of getting the coal would be lessened in consequence. The conditions for long-wall practice exist, and the system could be applied without risk or trouble.

The ventilation is provided by the natural forces, the currents of air sweeping along the main galleries from outlet to outlet. The workings are generally dry and comfortable, and the air above complaint.

North of Macksburg, near the village of Dexter, the Buffalo mines are opened on the same seam of coal. They have not been running during any of the visits to this region, and so have not been inspected.

The Washington mines, situated south of Macksburg, are also idle, and have been for upward of two years.

COSHOCTON MINES.

The manner of mining in practice in this county is by working forward single entries on the face of the coal, and single entries on the butts. None of the mines are as well ventilated as they should be; the system is a rude one, and the necessary attention is not given to the distribution of the air, even with the rude plans in practice. The butt entries are opened in the Pen Twyn Mine every one hundred and twenty yards, and rooms are turned off from both sides of the entry. The air is taken up one side of the entry through a series of crossings made from one room to another, and is returned down the entry to be re-distributed in the advanced ranges or lifts of the workings. The entry-drivers can not work far ahead in the fast for want of air, and the number of men at work on both sides ahead of the air, turning rooms, is such that there is never as pure a ventilation as ought to be had. I have urged this coal company to drive double entries, but they affirm that, owing to the necessity of lifting bottom or blasting top to make hauling height for the mule-roads, the extra expense under the present depressed condition of the coal trade could not be borne. I have then urged that the entrymen should be authorized to break off all the rooms on the air-way side, and hole them through, and that air-doors should be provided to the rooms before the miners commenced work in them; but this they also object to, as adding expense. There can be no expense whatever attached to this method, unless the men who break off rooms are not paid an adequate price for doing so.

The rooms of this mine are first started off at seven feet wide, and then opened to eighteen feet, pillars of fifteen feet in thickness being left between the rooms. After a range of rooms are worked up, the pillars are attacked and withdrawn, and the hill falls down. The floor of the mine, a soft and yielding fire-clay, first gives way; it heaves up till it sometimes meets the roof. These old wastes are receptacles of two gases, white-damp and black-damp, which frequently annoy the miner. The white-damp is formed from the pyrites of iron in the slack coal of the gob-wastes, which breeds heat or spontaneous combustion, particularly when water is admitted. On the south of the main entry some of the old works to the dip, after being abandoned, become filled with water. In approaching this part of the mine bore-holes were kept in advance of the workings, and the water was tapped and drawn off without injury to the mines or the miners. After the water was withdrawn the slack of the goaves took fire by spontaneous combustion, but by cutting off the air-supply the fire soon died out. This part of the mine can not now be penetrated, being a receptacle of deadly gases.

In approaching the line of the Coshocton Coal Company the rooms have also, in several cases, holed through into the waste of the Bench Hollow Mine, liberating water and black-damp. This part of the Mine was very poorly ventilated on the occasion of my last visit to the district. The noxious gases from the old workings of Bench Hollow Mine, every time an opening was made, would spread through the rooms and pollute the air of the mine. The south entry was nearly through to day, which, when completed, would renew the circulation.

The proprietors of the Pen Twyn Mine, when these old workings were first tapped, notified me of the fact, and claimed that the Coshocton Coal Company had trespassed on their mineral property. I urged the necessity of building air-tight stoppings, as soon as a break-through was made, to confine the foul air in place, and that the matter of damages for trespass could only be settled in the courts. As this is the third case of trespass which has come under my observation in the past twelve months, I would recommend that some legislation be had on the subject. It is not sufficient to define the liability for trespass, but it is necessary that all adjoining coal companies should be required by law to leave a solid pillar or barrier of coal between mines, fifteen feet thick on each side of the line, to prevent the possibility of a volume of confined water breaking through from an abandoned mine to one in operation. In the early history of our coal mines this question should be defined before the occurrence of accident.

The Home Mine, operated by the same company as the Pen Twyn, is worked on the same plan. The main entry is on the butts of the coal running eastward. The ventilation is in a fair state in all of the rooms outside of the last break-through, but inside of the current, particularly when there is tardiness in hanging the doors, the air becomes unfit for healthy respiration. There are three entries working, but the underground force of men is quite small. This mine has a good furnace for the requirements of the mine, and if coals are burned the air will circulate in abundance.

The Coalport and Summit mines, situate on the northern side of the Muskingum River, two and a half miles from Franklin Station, are opened within fifty yards of each other. These mines are operated by two different companies, who use one dump and one train-road. The main entry of the Coalport Mine runs north on the butts of the coal, and is twelve hundred yards long, but entries are opened on each side every eighty yards. The main entry is seven feet wide, and the butt entries are each six feet. The rooms are eighteen feet wide and the pillars twelve feet thick. Two air-shafts have been sunk in the main entry; the one nearest the mine mouth, which is eighty feet deep, is used for an up-cast, and the other, which is seventy feet deep, is a down-cast. A trap-door is hung on the entry outside of the up-cast shaft to prevent air from coming in at the drift-mouth. The down-cast shaft, near the face of the main entry, receives the pure air, which is sent round the workings before it comes in contact with the foul air generated in the wastes of the mine. This is a good arrangement, but the current is too feeble; and the plan of having single entries and relying on trap-doors in the rooms to get forward air, is too rude for good results. The fire used for rarifying the air at the bottom of the up-cast shaft was also very unskillfully applied. There was no arch to the furnace, and coals were burned to little purpose. I directed that a proper furnace be built, not as a matter of sanitary necessity alone, but as a matter of economy as well.

In opening up a range of rooms only one side of the butt entry is used, namely, the north side, following the rise of the coal. After the rooms are worked forward and finished the pillars are withdrawn, the inmost pillars being first attacked. By this arrangement very little pillar coal is lost. The floor of the mine first gives way in the excavated area, producing a creep.

. In the Summit Mine the main entry runs west for three hundred yards from its entrance, then turns south. The but entries are one hundred yards apart, the rooms are twenty feet wide, and the pillars ten feet thick. A main air-course ten feet wide follows the face entry, forming a double entry, but all the butt entries are single. The moving current of air was very feeble, and by reason of rooms being opened ahead of the circulation in the butt entries, the air was bad at the entry-face and inmost rooms. The boss informed me that he proposed to make all the new butt entries double in future—a change he will never regret.

TUSCARAWAS COUNTY.

The works of the Glasgow and Port Washington Iron and Coal Company are located in Tuscarawas county, three miles east of Port Washington and one mile north of the Pan-Handle Railroad, with which they are connected by a private branch road. Two blast furnaces, seventy feet high, seventeen feet bosh, closed on top with bell and hopper, comprise the iron works; and one coal mine opened in No. 6, several ore mines opened higher in the coal series, and one fire-clay mine, form the mining establishments. The mines are all drift openings and are level free. Only about twenty coal miners are employed, as the coal, although black and lustrous and of commanding appearance, is too largely impregnated with sulphur to fit it for use in the blast furnace. The seam varies in height from five to eight feet; the working places are dry and the ventilation good. The iron ore has, until recently, been mostly recovered by stripping or open-casting the superincumbent material and quarrying the bed in open day. The ore is known as blackband, and ranges from a few inches in thickness to twelve feet. It forms the immediate cover of coal seam No. 7, which ranges from four inches to two and one-half feet in height. Where drift-mining is resorted to in winning the ore, the miners undercut in the top of the coal seam and leave the whole of the coal in the mine, as it is too impure for any purpose required at the works. The blackband ore is not only of irregular thickness, but it is wanting altogether over large areas where it is due. The mine of fire-clay is from seven to eight feet of height, of good quality, but is not worked to any extent.

Only one of the two blast furnaces have been put in blast, though both are ready for work. The blackband ore is roasted at the mouth of the mine, and yields in this state fully 50 per cent. of iron. The fuel used in the furnace is Connelsville coke, a little of the coke from the coal of the company's mine being added. The ore used is the calcined blackband, with a small admixture of raw Lake Superior ore to darken and strengthen the iron. At the date of visit to the works, March 17 and 18, the furnace was casting three times in the twenty-four hours, and making a splendid number one foundery iron. The expressed opinion of founders is that the iron made from this blackband ore is equal to Eglinton and superior to Glengarnock Scotch pig, made from the famous Scotch blackband iron ore.

This company had in contemplation making search, by boring, for Coal No. 1 of the State series, the equivalent of the celebrated furnace coal of the Mahoning valley and of the Jackson region of southern Ohio, the place of which is from three hundred to three hundred and fifty feet below Coal No. 6. As, however, this is a very irregular seam of coal, and wherever it has yet been mined is found occupying long, narrow, and sinuous belts or swamps, the probabilities are against its existence except along the extreme margin of the coal field.

Between Coals Nos. 1 and 6 there are, in many parts of the Ohio coalfield, four other beds of a workable thickness, one of which (No. 4), where it is worked at Leetonia and Washingtonville, in Columbiana county, makes a very good coke, and is largely used in the blast furnaces of that district. Should no suitable coal reward the researches of this company, they propose to erect washing machines at the works to wash and clean Coal No. 6 of its impurities, and use it in the furnace. This is a practice successfully applied with many coals of an inferior character in Great Britain and on the Continent of Europe.

This company is composed of Scottish capitalists, and is superintended by Scottish bosses. All the various establishments are managed with the accustomed Scotch energy, prudence, and economy.

Of the ten other coal mines of this county, only three were working, and none of these with a full force of miners. The two mines at Pike Run, on the line of the Cleveland and Tuscarawas Valley Railroad, were visited and inspected. The Pike Run mines are opened in Coal No. 6, are drift openings, and have generally dry workings. The ventilation was promoted in mine No. 1 by the aid of a furnace, but it was too small, and the air-pit too contracted, for good results. The air was carried through the mine on the single entry plan, trap-doors being hung on the rooms to make a return and give motion to the air. A number of working places, near the face of the main butt entry, were in a defective condition, but workmen were employed in the entry, and in an opposite entry, on the other side of the hill, to meet each other and get through to day. They were within a few feet of meeting, and as soon as communication was made, the circulation would be renewed, and the air be made to sweep through the mine.

Mine No. 2 was without any furnace, and relied for ventilation on the natural forces, there being a main entrance to the mine, and an air-shaft for discharging the air. One of the rooms was being pushed forward to daylight, so as to carry forward the current nearer to the working faces. I urged that, instead of driving out to daylight, the room should be stopped, an air-shaft sunk near the room face, and a large and properly constructed furnace be erected at the bottom of the shaft. On my first visit to this mine, a year ago, an air-shaft had been sunk, and preparation was being made to erect a ventilating furnace. The furnace was subsequently built, but it had not been long in operation until the shaft took fire, which burned out the wood-work, and the shaft was filled up with the drift material and other débris.

This company has in practice in both of these mines a plan of laying the roads of the mine (rooms equally with entries) with T iron. This is a practice worthy of more general application. It is true economy; for two of the most important conditions of getting coal out of a mine consist in providing a good track and plenty of fresh air. Not only can the same number of horses haul more coal over a T iron track than one of wood, but the iron road costs less to keep it in repair, and the wooden rails of rooms, after being used once, are seldom fit to be relaid in a new room where the pillars are drawn as the workings progress.

POMEROY REGION.

Syracuse Shaft is eighty-five feet deep. It is sunk one hundred yards north of the river bank. No workings extend toward the river for fear of striking into the ancient bed of the Ohio. Where the shaft is put down, there is a cover of fifty-eight feet of rocky strata, but the coal and overlying strata are washed out in approaching the river.

This shaft was, unfortunately, sunk on the end slips of the coal, necessitating a rapid bend from the butts to the face of the seam, near the bottom of the shaft; and the mouth of the pit also faces up the river, instead of fronting the Ohio. The main entry runs west from the bottom of the shaft for thirty feet, then turns north for three thousand feet, following the face of the coal. The butt entries run east and west, at right angles with the face entry. All the entries are made double, the thickness of pillar left between the parallel headings being from twenty-four to thirty feet. The rooms are twenty-five feet wide, but are broken off only twelve feet wide, They are worked forward twenty-five feet before the full width of room is attained. The size of pillar between the rooms is fifteen feet, and air-ways are cut through from room to room after the rooms have advanced half way. The ranges or lifts between the butt entries upon which rooms are opened are one hundred and seventy to one hundred and eighty yards thick. The rooms run to the north and south on the face of the coal, and meet in the middle of the block. The pillars are left standing until all the rooms of the mine shall have been worked forward and finished, when the inmost pillars will be attacked and withdrawn.

In working forward under the massive hills fronting the river a cover' two hundred and fifty or three hundred feet is reached. Pillars of fifteen feet in thickness were found insufficient to maintain this superincumbent strata. The floor of the mine, a damp and soft fire-clay, was the first to give wav, the pillar sinking into the pavement until the roof and floor would meet. To guard against this danger, the rooms are now laid out in panels, sixteen rooms to each panel, then a solid pillar eighty-four feet in thickness is left, and beyond this a second panel of sixteen rooms is again laid out, and so on, until the boundary of the mine is reached. On the east parallel butt entry the panel pillars, instead of facing the ones on the west side, are equidistant from them, giving greater strength to the whole. Since this practice was adopted no creep of the floor has occurred. If these panels are strong enough to prevent a creep or crush from overrunning them after the pillars are attacked and partially withdrawn, every requirement of the mine will be served; but no harm and much good might be the ultimate result if these panels were made one hundred and fifty or two hundred feet thick, instead of eighty-four feet.

This mine has three openings, beside several entries, which have been worked through on the slope, situate one-fourth of a mile down the river. The hoisting-shaft is the down-cast. The air-shaft is eighty feet deep, seven by ten feet wide, and has a wooden stock, forty feet high, placed over the mouth of the pit. This air-shaft is divided into two compartments, in one of which a ladder is placed. The other compartment is the up-cast of the mine, at the bottom of which there is a roomy and well-constructed furnace. It is six feet four inches wide, the grate bars are four feet eight inches long, the arch above the bars is three and one-half feet high, and the length of furnace is thirty-eight feet. From fifteen thousand to twenty thousand cubic feet of air can be maintained by a free use of coal. The air-current, after descending the mine by the down-cast, follows the main entry until the west butt entry is reached; it then passes up one butt entry and returns by the other, then crosses over to the two east entries, passing up and down the parallels in the same way as on the east side, and is finally delivered at the surface through the furnace shaft The rooms, which are worked forward eighty yards, are holed from one to the other after they have advanced half way. The heads of the rooms are thus always in the most feeble state of ventilation, while those rooms newly started from the butt entries have a good play of air.

When a range or lift of rooms is finished, the air is taken from the entry, and this part of the mine is laid dead, to be reventilated when the pillars are attacked. There have been six butt entries opened on the west side of the main face-entry, and five of them have had their rooms all worked up. On the east side five entries have been opened, two of which are worked forward to the boundary of the coal property.

The Syracuse Slope is sixty-two and a half yards long, with an dip of one foot in three. Its entrance faces the river. The main entry runs north two degrees east, following the east line of the mining property. The main and butt entries are double the thickness of pillars left between the parallels in the face-entry, being twenty-four feet, while eighteen feet are left between the butt parallels. The rooms are made twenty-four feet wide and are broken off fifteen feet wide, the miners beginning to widen out gradually after the first two shots are fired. All the butt entries run to the west; the third, fourth, and fifth entries have each run into a gravel-bed, and where this occurs there are seventy-five feet of cover on the coal. This gravel-bed is evidently an ancient bed of the Ohio River.

The workings of this mine extend under the bottom land of the river, and having a greatly lighter cover than the extended workings of the Syracuse Shaft, require no strong panel pillars to maintain the workings against a creep or crush. The deeper the cover over coal the thicker the pillars required to support the mine.

The ventilating furnace of this mine is five feet wide and twenty-three feet long, with an arch three feet high. The up-cast shaft is one hundred feet deep, with a wooden stock fifteen feet high placed on top

The rear part of the ventilating furnace was contracted in width in erecting it to make it draw better, on the principle that house-chimneys draw best when they are made narrowest immediately above the fireplace. A good purpose is served in the case of the house chimney, but not so with the ventilating furnace of a coal mine. Contracting the size of the furnace beyond the fire, or having too small an up-cast shaft, simply and only confines the heated, expanded air in its passage upward, and so lessens the volume escaping. The narrowest place of the furnace ought to be near its mouth, where the fire is kept up, so as to heat the air as much as possible as the wind flies over the fire. In constructing the furnace, however, it should be made of uniform width, as the burning coals fill up all the necessary space; indeed, some furnaces are frequently too well filled up with coals. A broad, thin fire serves the best purpose of all.

The next mine, in descending the river from Syracuse, is that of Ebenezer Williams, at the village of Minersville. This mine is a drift opening, the rise of the strata having brought the coal above water. The main gallery runs a few degrees to the north of east for five hundred feet from the mouth of the mine. At this point two face-entries, one to the north and the other to the south, run on the butts of the coal to the boundaries of the mine property. The main butt entry, which runs through the center of the mine, extends fifteen hundred feet from the point where the face-entries are opened, its course being changed to run with the butts. One hundred and sixty yards north of the main butt entry, and the same distance on the south, two butt entries extend forward, making six ranges of rooms to the mine. All the entries are double, and are separated by a pillar eight yards thick. The rooms are opened on the north and south; at first they are made only seven feet wide, then extend seven yards in this narrow manner before they are opened out to the ordinary working wideness—eight yards. The newer rooms are now broken off sixteen feet wide; the thickness of pillars between the rooms is sixteen feet, pierced every thirty yards for air.

A new slope has recently been sunk near the face of the workings of this mine. It is four hundred feet long, and has a pitch of forty-five degrees. It is divided into two compartments, one of which is a traveling-way and the other an up-cast air way. The partition is brick the whole length of the way. At the bottom of the up-cast a steam-pump is located for pumping out the waters of the mine. Two boilers, supplying steam for the pump, are placed alongside of the pump. There is also a five-foot ventilating furnace located here. The heat raised by the exhaust steam, by the furnaces of the two boilers and by the ventilating furnace of the mine, all unite in rarifying the air, and produce a powerful ventilating current.

The mine receives its air from two intakes—the main opening and a drift opening situated further down the river. Both currents are kept apart and ventilate separate divisions of the mine, each stream returning to the up-cast by independent routes, when, uniting at the furnace, they are delivered to the outer world through the slope. As two breakthroughs are also made to each room, the workmen are never as far in the fast as in the other mines, where only an air-way is cut between the rooms. With every visit I have made to this region I have found a stronger and a purer mine atmosphere prevailing in this mine than in any other mine of the region, and the underground workmen better satisfied. I have never received a complaint of bad air in this mine.

The five mines of the Pomeroy Coal Company are known in descending order as the Minersville, the Excelsior, the Peacock, the Dabney, and the Diamond. They are all level free, though during very high water the Minersville bank mouth has to be dammed up with clay to save it from being flooded. In passing down the river, which here flows along the rise of the strata, there is a marked difference of level of the various mines. At Pomeroy the coal is forty feet above high water.

The first systematic coal mining on the Ohio River below Wheeling was commenced in the Pomeroy region in the year 1833, in which year coal first entered into domestic use in the river towns. In 1836 a steam tow-boat, named the Condor, built at Pomeroy, took a load of barges to Cincinnati. This was the first tow-boat on the Ohio River. The scheme of towing coal, an article of so little value and such great bulk, so great a distance as two hundred and twenty-five miles, was ridiculed by the steamboatmen of that day as a visionary enterprise. In 1839 the Lake Erie, another tow-boat built at Pittsburgh, commenced towing the Monongahela coal down the river to Cincinnati.

The mines of the Pomeroy Coal Company are very extensive, the Peacock and the Dabney being nearly one and a half miles from their entrances to the faces of the advanced workings. The country back from the river is cut up by numerous ravines, and the mines pass through from one hill to another till, in the cases of the Peacock and Diamond mines, the fourth hill from the river has been entered and workings opened there.

The Peacock Mine is opened on the butts of the coal, the main entry running west until it passes through the first line of hills, 1,466 feet from the entrance. The entry then crosses Nebraska Hollow, and enters the second hill in a northerly course on the face of the coal, and emerging on Union Avenue, 3,893 feet from the mouth of the main opening. On entering the third hill the entry continues north to a point 5,224 feet from the mouth of the main opening, thence it turns to the west on the butts, coming out again to day in Thomas's ravine, 7,255 feet from its commencement. The entry, at the date of visit to this region, in June last, had penetrated the fourth hill 855 feet—8,100 feet in all.

The lines of the Dabney Mine are also very extended, though the workings are confined to the first two hills. The faces of the Manasses and Athens entries, by the hauling-roads of the mine, are nearly two miles apart. The Athens entry has received this name from the driver-boys, who assert that it is near the village of Athens, the capital of the county of that name.

The roof of the mines is composed of a light shale, varying in thickness from a few inches to fifteen feet. This shale ordinarly makes a remarkably firm roof in the room workings, but along the entries, where it is exposed to the moving currents of air, it is continually crumbling and falling down in pieces, until, in numerous places, a groove has been cut in the ceiling the whole thickness of the shale. The entries are often fifteen and twenty feet high, and are very dangerous, for a small piece of slate falling such a height and striking a passer-by brings death or permanent disability to the hapless miner. The loose fragments ought to be regularly examined by the roadmen of the mine and made secure, or taken down.

The system of working in practice in all the mines of the Pomeroy Coal Company is the same. Double parallel entries in each gallery eight feet wide, with a thirty-foot pillar between them, are driven along the face of the coal. Double parallel butt entries are opened to the right and left of the face entry every one hundred and sixty yards. The rooms which are broken off the butt entries and are worked on the face of the coal, both north and south, are started seven feet wide, and are advanced fifteen feet before they are opened out to their full width—twenty-one feet. The thickness of the pillar left between the rooms is eighteen feet. Air-holes are made between the entries and rooms every forty yards. Larger pillars are left in these mines than in any other of the region, and the rooms are also worked narrower—and this is true wisdom. The pillars are attacked and withdrawn as soon as the rooms of a range of workings are wrought forward. The mines all being drift openings and level free, the conditions for extracting the pillars, as the mine progresses forward, are highly favorable to this system of working a mine. In removing the pillars, all the coal is not recovered, as a part is necessarily lost by the falling and crushing of superincumbent strata, but eighty per cent. of the whole is won, which is a very favorable showing.

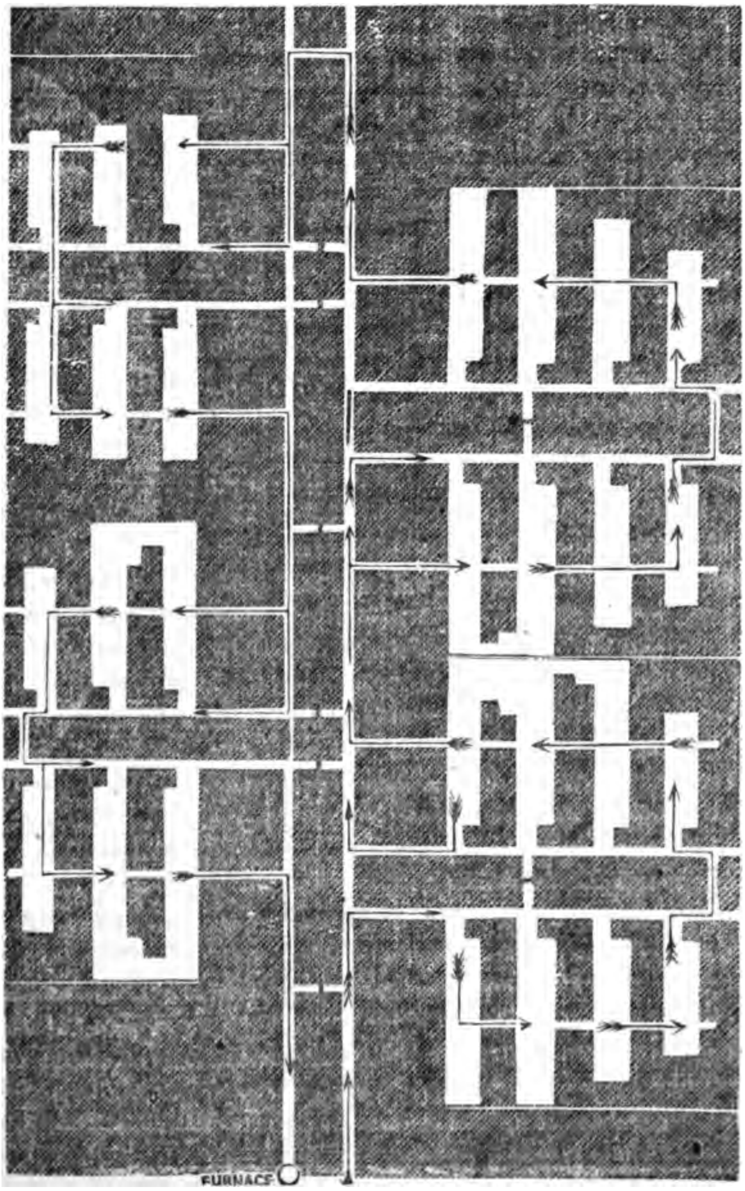
The pillars first withdrawn are those in the first range of rooms. As soon as a butt entry has been driven forward to its point of destination, and all the rooms worked forward, an attack is made on the four inmost pillars. They are brought back in *echelon* in order to throw the weight of the crush which follows their extraction off the pillars and forward in the exhausted area. The roof is held up by a free use of props, and seldom falls in any great masses until the air-crossing in the center of the pillar is reached, when the slate falls down, the rock strata above still standing firm. If the shale is fragile, pillar-work is extremely dangerous. During an inspection of the Peacock Mine last June, a miner was killed at pillar-work by a fall of the treacherous shale while I was in the mine, and in the same entry where the accident occurred. A son of the unfortunate man was at work on the same pillar at the time, and narrowly escaped the fate of his father. The boy had been twice knocked down within two weeks by falling shale. When the first range of pillars are brought within fifteen yards of the entry, the work of retreat stops for the time being, and the miners change front, attacking the entry stumps on the butts of the coal. After the first range of four pillars have been thus withdrawn, a new range is attacked as before, and the work of extraction continues—the slate first falling down behind the miners. When sufficient space has been cleared to allow the massive sandstone above the slate to break, a week or ten days transpires before it finally gives way. The rending of the rocks is sometimes terrific. Loud cracking and rumbling of the monstrous strata overhead are constantly heard, the noise sometimes loud and sharp, and anon resembling distant thunder. Fragments of the pillar coal also break and fly off, but the skilled and intrepid miner works on in defiance of threatened destruction; and when the final fall is about to occur, he retreats under cover of the unremoved pillars, and listens undismayed to the noise of a mountain three hundred feet in height falling with terrific fury in the excavated chambers of the mine a few hundred feet beyond. A coolness and intrepidity is here displayed never suspassed on any field of battle.

The long lines of road in these mines has made hauling underground very expensive. As all the main galleries run to the west and north, the grade is a little up-hill, and this is a great natural advantage. The hauling mules along the main entries are worked on the double-team system. Two mules hitched up together haul a train of cars, twenty or twenty-five in number, along the galleries of the mine. There are several sidings to each mine, so that the mules which haul outside never visit the working places of the mines. In the Peacock Mine the mules which haul outside traverse the entry for nineteen hundred feet, and get their trains there. A second set of mules haul from a siding two thousand feet further in, while a third series gather the cars from the rooms of the miners and bring them out to the middle station.

The main roads are all laid with strip iron. This kind of rail belongs to a by-gone age, and is now seldom seen in any extensive or well-regulated mine. It has nothing to recommend it, and ought to be thrown aside for a good T iron rail. A mine locomotive would also be a labor-saving machine in these mines, though, owing to the fragile shale roof, there might be increased danger of accident on the main road.

The mines of this company are all ventilated by furnace power. Usually there is no air-shaft, but at the entrance of the mine a stone shaft is erected, through which the return heated air of the furnace is discharged. As this shaft is quite low, not exceeding forty feet in height, there is not power even with a large fire in the furnace to give rapid motion to the air. The best furnaces at any of the mines can not move more than six or eight thousand cubic feet of air per minute, and then the fire has to be maintained at its highest power.

Owing to the long lines of level, and the extraction of the pillars in working progressively forward, the air of the mines is often loaded with the gases formed in the waste. The air flows along the butt entries, and the rooms, worked forward forty yards ahead of the moving current, have frequently an impure atmosphere, particularly those rooms on the return and where powder is freely used. The miners in one division of the Dabney Mine early last spring complained of bad air. The entry was approaching the outside, and was being driven single to avoid expense. Doors and stoppings were applied after complaint was made, and the air became sweeter.



PROPOSED PLAN OF WORKING AT POMEROY.

Several of the entries in the second hill of this mine have been driven out to day to give natural ventilation to the mine.

The assistant mining engineer of this company, Mr. Thomas Middleton, has proposed an improvement in the manner of ventilation, which, when applied, can not fail to produce better results than are now attained. The present plan, as already stated, is to take the moving current ot air along the galleries of the mine, allowing it to diffuse itself as best it may through the rooms, by cutting air-holes from room to room after they have advanced half way. The proposed method is to take the current off the entry and send it through the crossings between the rooms, as soon as these crossings are made, so as to have the circulating stream forty yards nearer the working faces when the rooms are being finished up. To do this effectually, an air-passage would be required to be cut from the first room to the main entry, through the thick thirty-yard pillar, though a swinging door placed on the butt entry between the first and second rooms would force forward the current into the crossings with reasonably good results. (See plan on page 35.)

There are several other mines in the vicinity of Pomeroy and Middleport. The Pamunkey, which was running a full force of men last year on pillar-work, has been finished up and abandoned during the present year.

Pomeroy's Mine, a work long standing idle, has been undergoing repairs and will soon be ready for shipping coal by the river. The main opening of the mine fronting the river has recently been re-timberod for one hundred yards from its entrance. The timbers used are hewn wood, and are erected in a mastefly manner, surpassing any work of the kind in the State. This mine has been driven through the first hill

The Coal Ridge Bank, which usually employs a force of thirteen men, was idle at the date of my visit to the region, as was also the mine of the Middleport Salt Company. Both of these works mine coal for use in the salt furnaces of the place, and do not ship coal by the river. Another mine, the property of the Buckeye Salt Company, was also idle. These three mines are each level free.

The Cheshire Mine, the lowest of the series of the Pomeroy region, is in Gallia county. It works a small force of men, usually from ten to fifteen. The mine is opened on a rounded hill, fronting the river. Two entries are driven out to day, one on the right, and the other on the left of the main gallery of the mine, and the ventilation is by the natural forces. The coal is here a double seam. The upper bench, which runs from fifteen inches to two feet in thickness, is not worked, and it makes a firm and safe roof. There are two inches of slate between the two coals. The lower coal is usually about four feet thick, and resembles the coal of the mines at Pomeroy in character and quality.

IRONTON REGION.

The mines of Lawrence county are located at Newcastle, near Hanging Rock; at the Iron Railroad tunnel, six miles north of Ironton, and at Sheridan, seven miles south-east of Ironton. The Newcastle mines were running very light, and were not visited. Those situate at Iron Railroad tunnel are three in number, the Lawrence mines, the Bellford mines, and the Iron and Steel mines. The tunnel is driven its whole length through the coal seam on which the mines are opened, the roof of the tunnel being the roof of the coal seam. The Lawrence Mine is situate north of the tunnel, the Bellford, and Iron and Steel mines being on the south side. The roof of the coal is often sandstone, firm and hard. Sometimes a stratum of light slate, called soapstone by the miners, appears between the coal and sandrock. The floor is fire-clay, very dry, and the working places of the miners are safe and free from water. The coal seam is from three to four feet in height, with a band of fire-clay from one to five inches in thickness ten inches from the bottom of the coal. The mines are all level-free, and have each several modes of ingress and egress, but the ventilation is not in a praiseworthy condition, though some of the mines are in much better order than others.

The Lawrence Mine, of the Lawrence Iron Works Company, enters the hill on the butts of the coal, running a little south of east. After advancing well under the hill, a face entry, running southward, is opened. The workings on the right of this gallery approach the tunnel, and all rooms are stopped one hundred feet from the tunnel, to guard against a crush in the mine overrunning the tunnel.

This mine is ventilated by the natural forces, one of the entries running through the hill. All the entries are single. The butt entries are one hundred and twenty yards apart, with rooms working off both sides. The rooms are seven to eight yards wide, with pillars four to five yards thick between them.

There was a good stream of air passing along the air-course, but the straight entry was far ahead in the fast, beyond the reach of the moving current of air. This entry was, however, idle. Seven rooms in this entry were not as well ventilated as they should have been, but arrangements were in progress to improve them.

The Bellford mines are opened on the butts of the coal, the main entry running eastward for six hundred yards. There are five butt entries in all opened up, each separated from the other one hundred and twenty yards. The rooms work on both sides, and meet in the middle of the block. They are started off the entries at three yards in width, advanced four or five yards before being opened out to their full width, seven yards. From four to five yards of thickness of pillar is left between rooms. The pillars are drawn as soon as the rooms meet. They are brought back within fifteen yards of the entry and there stopped. The roof being a strong sandstone, does not give way immediately after the pillar coal is removed, and sometimes, after a long stretch of pillars, embracing an area of one hundred yards wide, and two or three hundred yards long, have been removed, the exhausted space will stand six or eight months before the superincumbent rock breaks and falls.

This mine has an air-shaft and furnace, and has wind at command at all times and seasons for the ventilation of the mine. If bad air exists, it is due to the want of the necessary air-ways. The plan of distributing the air is by driving air-courses from one butt entry to another, and until those air-courses are finished, all rooms and entries beyond the reach of the current have bad air. When this mine was inspected, in July, 1875, there were many places where the air was unfit for the abode of the miner, but a marked improvement has since been made in the ventilation, though some places are none too good yet.

Stall entries are sometimes driven in the butts of the coal, that is, wide entries, from which rooms are worked on one side only. By reason of the firm roof, all the butt entries might be made wide, and so lessen the cost of mining, while it improved the ventilation. The height for the hauling-road is taken out of the bottom, a moderately soft fire-clay. In the narrow entries this refuse material has either to be hauled outside and dumped there, or taken into the goaves and thrown out. In wide entries, say fifteen feet, it could be used for an air-course in building a pack-wall between the pillar and the track on the blind side of the entry. By this arrangement the air-current would always be within a few feet of the entry-face, and air-courses would not require to be driven from one butt entry to the other. And to make the plan a success, the lower, or first butt entry, should not only be made narrow, but should have a strong pillar of solid coal standing between it and the second lift or second butt entry; in other words, it should be a double entry. Were the mine divided into panels or blocks, and the main hauling-roads permanently preserved by strong pillars along their flanks, it were possible to recover every ton of coal in the hill.

The Iron and Steel Mine enters the hill by angling across the face of the coal in a north-west direction. The butt entries are eight feet wide, and, as in the two mines already described, one hundred and twenty yards apart. The rooms are started off at eight feet, advanced sixteen feet, and then opened to twenty-one feet, their full width, the thickness of pillars being four to five yards. This mine has an air-shaft sixty feet in depth, and three drift openings, but there is no furnace or other ventilating power, except the forces of nature, which are too feeble and unreliable. The workings are well advanced, the mine having been in operation for twenty years or more. There are five butt entries working at present, one of which is named the Penitentiary by the miners, by reason of the thin and hard coal prevailing in this part of the mine.

Those parts of the mine swept by the air currents, as they pass to and fro along the various passages leading to day, have a good state of ventilation, but the entries and other working places ahead in the fast were not in real good condition. In half a dozen working places in the Penitentiary entry the air was so foul that I suggested the removal of the workmen to a better ventilated portion of the mine until an air-way in progress could be got forward.

The Sheridan mines were doing very little work at the time of inspection, and were not carefully inspected. The main gallery runs in the face of the coal, pursuing a course ten or twelve degrees to the east of north. The butt entries to the right of the face entry follow the line of dip of the coal, and when advanced in this direction make water. There are two shafts in use for ventilation, and for pumping water, but along the main air galleries there was no motion of air, and at the working faces, where the people were employed, the ventilation was in a very defective condition, a lamp burning with difficulty, owing to the amount of black-damp in the mine atmosphere. The mine boss informed us that this state of the air was due to the mine being idle, and without attention.

The roof over the coal is a firm fire-clay four to five feet in thickness. It stands reasonably well in the rooms, admitting of working places seven to eight yards in width. Along the main roads, however, where it is exposed to the moving currents of air, it falls down in fragments, until the sandrock is laid bare. The butt entries are one hundred yards apart, the rooms working from both sides, and meeting half way. When weight comes on any part of the mine, by reason of the extraction of the pillar coal, a creep results, the bottom rising and closing up the excavated area.

The plan of working this mine has been sketched in advance of working by an engineer, and consists of three face entries, each seven hundred yards apart, running in parallel lines, and a series of butt entries, each one hundred yards apart. As, however, the entries which run eastward dip and make water, it was found impracticable to follow the plans, and a new opening has been made farther up the river on the dip of the coal, in order to work all the butt entries to the west on the rise of the strata. A face entry in the interior of the mine was started to be run out to day, but it dipped and made water and was stopped. The new opening will strike through in this gallery, the work having been surveyed before the mine was started.

The new mine dips as far as the entry has yet been advanced, showing the presence of a trough or low place between the two entries, which are meeting each other from opposite directions. This trough is the result of the massive strata, 300 feet in thickness, pressing or bending the strata near the outcrop of the coal, where the hill slants downward toward the river. This is a general—almost a universal—occurrence in drift-mining regions, the coal rising in all directions toward its outcrop. And it is a condition of mining not well understood. Hundreds of thousands of dollars have been fruitlessly expended in opening mines in consequence. At the Steubenville Furnace and Coal Company's mine the shaft was sunk near the Ohio River in ground where little rocky strata was known to exist, and the main gallery, in advancing toward the bluff, dipped sixteen feet. The shaft at Hamley's Run was opeped on just such a place, and the galleries dipped thirteen feet.

Two large blast furnaces have been built within the past year at Ironton, one of which is now in blast. The height of the furnaces is eighty-one feet, with eighteen feet bosh. The furnace in blast makes sixty tons of No. 1 foundry iron in the twenty-four hours, at a cost of thirteen dollars per ton, exclusive of interest on the capital invested. The ores used are native ores, yielding forty-five per cent. of iron when calcined. A little mill cinder is added to the ore. Fifty bushels of coal, or their equivalent in coke, are used in the manufacture of a ton of iron. The fuel is mainly Connelsville coke, with raw coal added, say one-fourth. The height of the furnace is fifty feet, the other part consisting of retorts.

JACKSON COUNTY MINES.

There are six blast furnaces using coal, and nine shaft openings, in and around Jackson Court House. The shafts are, namely, the Orange shaft, the Star shaft, the Globe slope, the Fulton shaft, the Tropic shaft, the Huron shaft, the Eureka shaft, the Erie shaft, and the Kyle slope. At the date of visit to this district all these mines, with the exception of the Globe slope, were idle. The mines are mainly run to supply coal for use in the blast furnaces of the district, and owing to the depressed condition of the iron trade, all the furnaces but one are out of blast. The Globe slope was working forty miners. There is an air-shaft and ventilating furnace, and there was good air in the mine. The rooms of this slope are eight yards wide, with pillars two yards thick and twelve yards long. The roof is a hard rocky shale, and the cover over the coal is less than one hundred feet at the deepest points. The main entry is double, and advances on the face of the coal, its general line of bearing being five degrees to the east of south. The main entries are three in number, and are each followed by an air-course four yards wide. A car truck is taken up on each air-course, as well as entry, and rooms are opened to the right and left on the face of the coal. The wavy and undulating coal floor causes considerable expense to attach in advancing the main entry. As the lower places are generally bowls, and not troughs, the entry is pushed boldly forward on the face of the coal. The hills are shot down, and the hollows filled up, so as to make the main hauling-way as level as expedient. In encountering a hill on the butts of the coal, however, the heading is stopped on reaching the summit or line of reverse dip, and advantage is taken of the low places in the mine to get round the base of the hill.

At Young America, two miles north-west of Jackson, several drift mines are opened in the Jackson Hill coal, the equivalent of the Wellston coal, the most extensive of which are the mines of the Pitrea Coal Company. These mines were visited, but were not examined. The floor of the coal appears to be less undulating than at Jackson, and the coal extends over greater areas without breaks or wants in its continuity. The seam is a little thinner than at Wellston, but is still of workable height.

The Wellston shaft is forty-five feet deep, and has an air-shaft. The entries run in the butts of the coal, and are opened on both sides of the shaft. The rooms are made eight yards wide, with four-yard pillars. There are no face entries started yet, and the rooms are broken from off both sides of the butt entries. The ventilating current of air is assisted by means of a steam pump placed at the bottom of the hoisting shaft. There are no air-courses in the mine, and the air, after entering at the air-shaft, passes direct to the up-cast along the main entry. The cages are without covers or safety-catches. Arrangements were in progress at the date of visit (May 22) to build a six-foot furnace at the bottom of the air-shaft, and reverse the ventilation; also to erect doors and stoppings to throw the current of air toward the room faces where the miners were at work. This is a new mine, having been opened less than eighteen months. The coal lies flat in the ground, subject to local dips, and with the natural dip to the south-east. The shaft is opened at the proper place to work all the coal to the north and west on the natural rise of the strata.

The north butt entry, from the bottom of the air-shaft, is made double. The south entry is also double. If care is taken to carry forward the air, after the proposed improvements are made, there ought to be no complaint in future. If there is complaint, it can only arise from bad management, for all the conditions exist for tasteful and inexpensive working and ventilation.

The Milton Shaft, also at Wellston, is seventy-five feet deep. The face entry runs to the south. The butt entry is double, and angles across the coal to the south-west. This mine has an escape shaft and ladders for the miners to go up and down at pleasure. The ventilation is promoted by means of the exhaust steam from the pump at the bottom of the hoisting shaft. This mine was idle at the date of visit.

The coal from both of these mines is mainly used for smelting iron. There is one blast furnace at the Milton shaft, and two at the Wellston shaft. The coal is used in a raw state as it comes from the mines. The coal shaft and blast furnace are located side by side.

ZALESKI MINES.

The Coal Mount, or upper mine of the Zaleski Company, is opened on No. 6, the equivalent of the Nelsonville and Carbondale coals. The seam is in three benches, the lower bench being six to eight inches thick, the middle one two feet four inches, and the upper one six inches, making three and a half feet of coal, exclusive of the two shale partings, which add eight to ten inches more of working hight. The hill over the coal is less than one hundred feet high at the highest points, and the ravines cut down through the coal in numerous places, necessitating numerous openings. There are three openings in operation. The right bank is opened quarterly eastward on the face of the coal, and there are three butt entries, from which rooms are worked. The middle bank opens on the north, and has three butt entries on the east side of the main entry, and five on the west side. The third bank is a new opening, and has been little developed.

The butt entries are generally made every one hundred and sixty yards, and rooms work off both sides, rooms being eight yards wide and pillars two yards thick. There are numerous undulations in the coal floor, and the hills are so small that square and tasteful work can not always be laid out. The entries are driven out to day, and the ventilation is by the natural forces. The mine was in fair order.

The Zaleski, or lower mine, is opened on Coal No. 4, which is also in three benches. The upper parting of slate is sometimes one to one and a half feet thick, though its usual thickness is three inches to one foot. The mine is opened on the face of the coal, and two butt entries are working, one on the east and one on the west side of the main entry.

The rooms are seven yards wide, with ten-foot pillars. Three entries run out to day, and there is an air-shaft thirty-five feet deep, with furnace. The furnace is used in summer only.

The slack of the gob-waste in this mine soon becomes heated, owing to the presence of pyrites of iron in the coal, and all the old works have a high temperature; in one place the thermometer rose to 80°. I was under the impression that the slack in the gobs was on fire, resulting from spontaneous combustion, but the bank boss assured me that there was no fire in the mine. The heat thus generated by the gob produced a gas which English miners call stythe, which is very injurious to the health of the workmen. In close summer days, when the furnace is not kept up, the air becomes so foul that the men are sometimes required to leave the mine. The working places of the miners are the coolest parts of the mine.

HOCKING VALLEY.

The mines of Peter Hayden, in Hocking county, are the first of the series of the Nelsonville region in descending the Hocking Valley. They are opened near the outcrop of Coal No. 6, and consist of numerous drift mines, driven into and through the last of the series of the Hocking hills which hold this coal. The mines may be divided into the south mines and the north mines. The south openings lie in section 1, and border Athens county. The first mine opening now working is called the Sollett entry; the hill is nearly worked out, and the pillars are being withdrawn. Across Poplar Hollow a new entry is started into another hill. This entry is progressing to the east on the butts of the coal, and is dipping very fast. The light entry north of the Sollett has been worked out, but the main gallery is used for a tram-road to reach the coal from the workings on more northern hills. A mile north of the Sollett entry the Wallace entry of the south mines runs north-east through the hill. West of the Wallace entry the Wilber entry is located. The rooms in this hill are nearly all worked up. North of the Wallace entry the Cain entry passes into a hill of great extent, the main gallery of the mine being half a mile underground, and is not yet out to day.

The hills in course of operation do not generally exceed three hundred to four hundred yards in length, and the main entry is pushed through each hill as expeditiously as possible to get ventilation. Only the natural forces are applied, the air passing out and in at the many day-levels, according to the force and direction of the wind outside. The air is very generally in a fit state for the miners to work. During the fall and spring seasons, when the temperature of the mine and the outside temperature approach each other in density, the miners are annoyed with the powder-smoke hanging in the working places, but there is little or no complaint made from this source. The rooms are made eight yards wide, with pillars two to three yards in thickness between them. In former years the practice was to abandon all the pillar coal of the mines as lost coal, but now the pillars are sought to be won. Fully thirty-three per cent. of coal was left unwrought in pillar coal, twenty per cent. of which is now being recovered. The track in the mines in every entry and room is laid with T iron. The track is put together in sections, and is lifted and re-laid without trouble or cost. A small mine locomotive draws the coal from the drift-mouths to the shutes over a tram-road upward of a mile long. The horizon of the coal is one hundred and fifty-five feet above the canal at Haydenville.

The Lick Run Mine is the first of the series situated in Athens county, in descending the Hocking Valley. This mine is opened on the west side of the mining property, and the main entries driven to the east extend on the butts of the coal. Improvement has been made in the ventilating arrangements during the year in the erection of a furnace and brick air-shaft. This shaft, however, is too short for good results. When first erected a wooden stock was placed on top of the brick structure, but the heat from the furnace soon set it on fire, and burned it down. The place to sink an air-shaft has been selected beyond the face of the inmost eastern gallery, and until this point is reached with the entry, the brick stock over the present furnace should be lengthened fully forty feet.

The lower opening now working has been rudely worked, the pillars being too small, and the entry left without adequate support. As a result, the pillars are already giving away, and the mine is comparatively new. The practice of working with small pillars where the ravines are numerous, and the amount of coal in each hill less than twenty-five or thirty acres, is not commendable practice even there, and will surely bring ruin to a mine whose workings will extend in all directions for many hundreds of yards. This is a valuable mining property; the main gallery of the mine will last for thirty or forty years, and it should be made firm and strong beyond the possibility of danger. Pillars six feet in thickness between rooms ought not to be expected to hold up a hill two hundred feet high.

The Laurel Hill Mine, situated at Lick Run Station, is reached by a short incline plane. The roof of the coal at the entrance of the mine is sandstone, and in making the openings no prop-wood is needed. There are two openings, one of which runs south and the other east. Seventy-five yards from the mouth of the south entry a butt entry runs west. Two others running on the same line, each one hundred and fifty yards apart, complete the series to the west. There are also three eastern entries. They, too, are each one hundred and fifty yards apart, and seventy-five from those on the west side. The mine has an air-shaft eighty-four feet deep, and a furnace has been started at the bottom of it, but has not been completed. Single and double rooms are wrought, single rooms being twenty-four feet wide, and worked with one man, and double rooms being forty feet wide, having two roads, and worked with two men. The main entry is double from the air-shaft, and all the butt entries are started double. This mine has had frequent changes of inside bosses. The efforts made to lay it out right show that some one of them has been a skillful miner. The ventilation is good. Only a small force of men is employed.

Longstreth's Mine has two main openings, the Stokely entry and the North entry. They are within a few yards of each other at their mouths, but are driven forward at right angles, the Stokely opening running nearly weston the butts of the coal, and the North opening running nearly north on the face of the coal. The Stokely entry is eleven hundred yards in length, and passes through the hill. Rooms are opened only on the south side of the entry, the object being to keep this part of the mine strong, to get coal through it from newer and more eastern openings in future years. The rooms are started off the entry eight feet wide, and are advanced twenty-two feet in this manner, then widened out at once to their their full working width, thirty-two feet. Every second room only is opened in the entry, in what is known as the double-room method, the alternating rooms being cnt out of the left pillar side. The thickness of pillar between the second room and the entry is forty feet, an offset being made in the entry pillar at the alternating rooms to give this extra thickness. The length of pillar along the entry is eighty feet.

This plan of opening rooms was adopted to add strength to the entry, and was suggested in consequence of the crushes of the superincumbent strata which followed the extraction of the pillar, sometimes overrunning and closing the entry.

The North entry, following the face of the coal, is six hundred yards in length, and is driven to the boundary of the mineral property. There are six butt entries in this gallery—three to the east and three to the west. All the western ones are worked out and abandoned, the pillars of the rooms being also withdrawn. The eastern entries connect with the western entries of the Stokely opening.

There are six different openings to this colliery, three of which are on the south, one on the west, and two on the east. The four openings in addition to the two main openings are passages driven out to day for ventilation. The air passes in and out of these openings by the natural forces, and the currents sometimes move one way and sometimes another, according to the difference in density of the mine and outside atmosphere, the force and direction of the wind outside, or the motion given to the air by the movement of the mine cars outside. The mine is laid out into a series of blocks by air-courses driven on the face of the coal every six hundred feet. The butt entries are four hundred and fifty feet apart.

The rooms of the mine, as already stated, are made thirty-two feet wide, with pillars of twelve feet in thickness. Two roads are taken up each room, the left road being laid close to the left pillar side, so that the pillar coal may be filled to good advantage when the pillars are worked, while the right road is laid eight or nine feet from the right hand pillar. There are thirteen rooms in each block, and as all the butt entries (except the main Stokely entry) work rooms on each side, the rooms are finished up as they meet in the middle of the block. The pillars are then withdrawn, the whole series in the block being attacked at once. The first break or crush of the strata occurs after fifty or sixty yards of pillar coal have been worked back. Only one to five feet of roof slate now falls. If it hangs on the props and becomes dangerous, some of the props are knocked out to let it down. The second and final crush occurs after the pillars have been worked well back towards the entry on both sides, and six or seven acres of exhausted area are standing unsupported. The superincumbent strata, composed mainly of thick and strong masses of sandstone, grind and work for days before the final crush is heard.

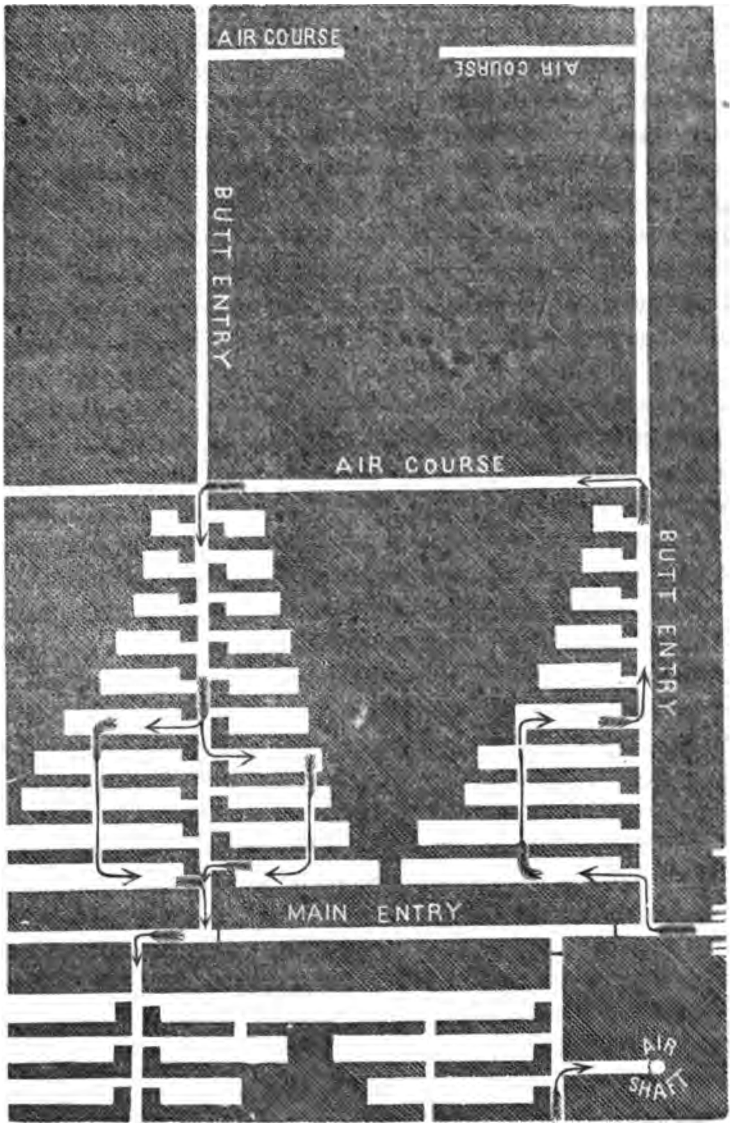
Poston's Mine, the next in ascending order, is opened on the face of the coal, and the main entry is advanced northward for four hundred yards. There are three eastern and three western entries running on the butts of the coal. These entries are one hundred and twenty yards apart, and have rooms opened on both sides. The rooms are started off at nine feet wide, worked forward fifteen feet, and then widened out to twenty-seven feet, the thickness of pillar between rooms being eight feet. There are three entries or air-courses running on the face of the coal, known as No. 1 north, No. 2 north, and No. 3 north. They are also one hundred and twenty yards apart, so that this mine is laid out in a series of square blocks, the entries crossing each other like latitude and longitude lines. There are ten rooms in each block. All the western butt entries run to the line of the Nelsonville Minning Company's property, and intersect the eastern butt entries of that company's mine. No. 3, northern entry, goes out to day, and the western entries, intersecting those of the Coöperative Mine, give ingress for ventilation from two main sources. The miners are all employed outside of the air-courses in the rooms, and only the entrymen are at work in the fast.

The Coöperative Mine of the Nelson Mining Company lies west of the Poston Mine, the main entry running northward along the face of the coal. This entry is about four hundred yards in length, and is still progressing. Three butt entries are opened in the east and three more in the west. Two of the eastern entries are worked forward to the line of the mining property. This mine is worked in all respects like Poston's.

The Coöperative Mine was opened in July, 1874, on a coöperative plan, the outgrowth of the great coal strike of the previous spring, when the negroes supplanted the strikers. About sixty members were engaged under the name of the Nelsonville Mining Company; all the members were miners except the four directors—Ashford Poston, Charles Robbins, John T. Welsh, and William W. Poston. Mr. Welsh was chosen prsident and superintendent, and Mr. A. Poston treasurer. The miners were to pay fifty per cent. each month of their earnings in the mine, until their shares of five hundred dollars each were paid up. Every thing went well for one year, the mine running steady and the stockholders being full of hope. Then the work began to slack off. The miners thought the directors were negligent, many of them even thought the loss of trade was done purposely, in order to induce them to sell out at a sacrifice. The directors declared they were doing their best, that trade was dull and coal could not be sold at any price. The miners finding themselves unable to pay their fifty per cent., and keep their families upon their scanty earnings, desired to sell out. The directors bought their shares, in some cases at twenty cents on the dollar. At the time of inspection of this mine, in August last, only three of the miners still retained shares, all the others having sold out to the directors at a great sacrifice.

The following plan shows the method of ventilation in practice in most of the mines of the Hocking Valley, where opportunity does not exist for driving through the hill with every butt entry. In this plan an air-shaft is shown. (See next page.)

The Floodwood Mines are on the west side of the Hocking River, four miles below Nelsonville, and are reached by a short coal road branching from the Columbus and Hocking Valley Railroad at Floodwood Station. The mines are opened on the ordinary plan prevailing in this valley. The entries are all single, and driven as far forward as they can be pushed, for want of air, and their air-courses are driven from one butt entry to another or to daylight, or an air-shaft is sunk to serve a temporary purpose. Four openings have been made to this mine, besides an air-shaft and a drill-hole, for the purpose of getting air, and at the date of visit the interior of the mine was again in bad condition. I sketched off a plan to the mine boss and one of the owners, to work by double entries and carry the air forward, as the workings progressed, instead of having to drive air-courses through solid blocks of coal, or run out to daylight every time an entry is advanced one or two hundred yards. These multitudinous openings to day serve no permanent purposes as air-ways; in-



PLAN OF WORKING IN HOCKING VALLEY.

deed, they do more harm than good, for the current draws and discharges at the two day-levels nearest together, and the balance of the mine lies virtually dead.

The two mines of W. B. Brooks & Son, known as section 19 and section 29, are situate on different sides of the Hocking River. Section 19 is on the north side, and the mines are in Hocking county. The coal is mainly brought from two entries in section 19, known as the Riddle entry and the Stogey entry. These openings are near each other, and their main galleries extend to the north on the face of the coal. In the Riddle entry the room workings are chiefly opened in Snake Hollow entry, which runs eastward on the butts of the coal. In the Stogey entry the rooms are chiefly opened to the west.

Several other openings are located in this neighborhood, from which coal was formerly drawn. Two ot these openings have fallen in, closing a number of rooms. The plan of working, long followed by this company, is to leave pillars only six feet thick between rooms. In hills with a light cover and limited area, this pillar generally suffices to hold the mine firm until all the rooms are worked up, when the mine is abandoned as wrought out, leaving all the pillar coal behind; but where the overlying strata are one hundred to one hundred and fifty feet thick, and the mine is calculated to last for several years, there is danger of a crush occurring before the domain to be won is half wrought over; in fact, a crush is certain and sure to occur, involving loss and ruin over a large part of the mine. If larger and stronger pillars were left, all the pillar coal might be recovered after the rooms are worked forward, as is done in the mines of the Pomeroy region.

In section 29 the mines are reached by a short tram-road extending through a tunnel 650 yards in length. This tunnel passes through the coal seam, and is in reality only an old entry of a worked-out mine. The coal is hauled from the mine to the shutes by a small mine locomotive.

In the mines on section 29 the workings extend along the Pickaway and Sheppard entries. Rooms are worked on both sides, and, as in Riddle and Stogey entries, in section 19, only six-foot pillars are left. To add extra strength to these entries, rooms in both mines are now being made double—that is, only every alternate room is broken off the entry.

The ventilation in both mines is by the natural forces, the air passing along the entries where the miners are at work. In the Pickaway opening there is an air-shaft; in the mines in section 19 the air-galleries pass through the hill. All the working rooms have break-throughs between them. The ventilation was good, and the miners were well satisfied with the sanitary condition of their working places.

The Hamleys Run Shaft is the last mine in descending the Hocking Valley which comes under the requirements of the mining law. Two shafts, one at Salina and the other at Chauncy, have been sunk and operated for many years, but have never worked more than eight or ten men at once, the coal being used to run the salt furnaces of the vicinity and to supply the local trade.

The Hamleys Run Shaft is sixty feet deep. The coal dips from the bottom in all directions, an unfortunate circumstance which could not well be foreseen in its location. It has an air-shaft, seventy-six feet in depth, sunk near the back of one of the entries. That part of the mine swept by the air, as it moves from one pit to the other, was well ventilated, but other portions were not, because of the prevailing practice of working the entries ahead of the air.

The rooms are worked twenty-six feet wide from both sides of the butt entries, the thickness of pillar being nine feet.

The Salina Shaft was visited and inspected, although, working less than ten men, it does not come under the provisions of the law. The shaft, originally a narrow one, has recently been enlarged and improved.

The Carbondale Mines border Vinton county, and are reached by a coal-road, six miles in length, extending from Mineral City to Carbondale. The coal, as in the Hocking Valley mines, is divided into three benches; the lower bench is six to eight inches in height, the middle bench two feet four inches, and the upper bench is ten inches, exclusive of fifteen inches of slaty coal too impure to mine. There are two main openings, both level free, which are only a few rods apart. The upper mine extends west on the butts of the coal, the lower one running north on the face. The main butt entry is double, a pillar of eight yards in thickness dividing the parallels. This pair of entries are in advance of the other butt entries, which come forward, one after the other, in *eschelon.* The rooms are started off at six yards wide, and extend to eight yards, six feet of pillar being left between rooms. The butt entries are ninety yards apart, the rooms working only on one side.

The ventilation is promoted by furnace power, a shallow air-shaft being sunk near the out-crop of the coal on the last butt entry, at the bottom of which a roomy furnace stands. The air passes up to the face of the right parallel, thence down the last opening of the left one to the air-courses (the room last holed through) leading to the second entry, thence it passes down this entry to the air-course leading to the west one, and so on till it traverses the mine. This mine was in good order.

King's Mine and Ingham's Mine, situate at King's Switch, one and a half miles west of Mineral City, are opened on the same seam of coal as the Carbondale mines, but only the two lower benches are worked. In King's Mine the main entry passes through two hills and into the third, the most of the workings being in the third hill. The main entry runs north for three hundred yards, then changes westward for two hundred and eighty yards, then wheels northward again on the face of the coal.

The butt entries are eighty-five yards apart, rooms working off both sides, when the conditions are favorable. When the rooms, going either east or west, dip, they are stopped and the coal wrought to the rise on the opposite side.

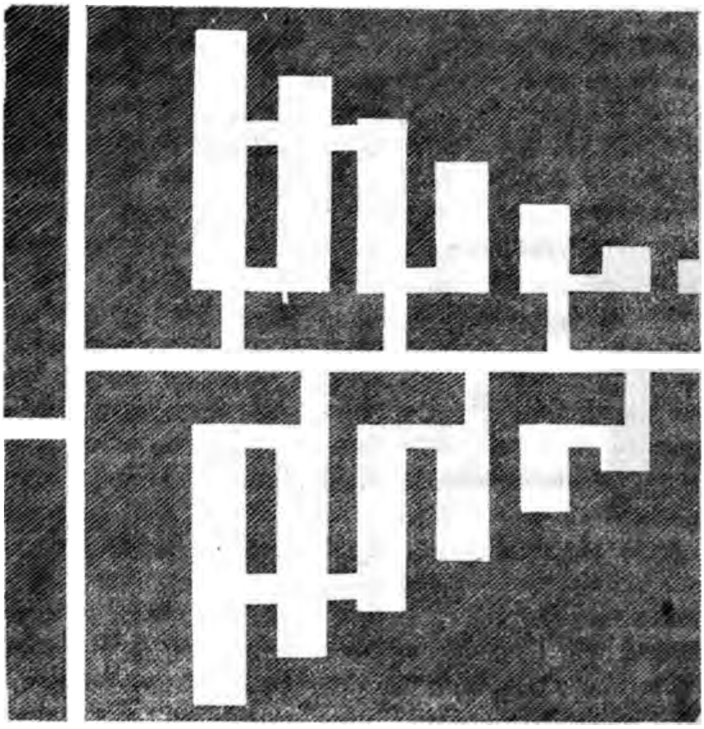
Ingham's Mine is wrought on the same plan as King's, both banks being under one management. The entries are driven through the hills, and the ventilation is produced by the natural currents. When rooms are single they are made eight yards wide; when double, nine and ten yards. In the double rooms two tracks are laid down, one on each side of the pillar. Owing to the lowness of the seam worked, pushers or haulers take the empty cars into the rooms, from the main roads, and push out the full ones. In Ingham's the pushers haul out to day.

STRAITSVILLE.

The mines of the Straitsville Central Mining Company are the most southeasterly of the Straitsville series. The openings are made in the north side of the mining property. The south side would have been the proper site, in order to work the coal to the rise of the strata, and thus obtain both natural drainage and a downward grade for the full cars in the mine; but physical obstacles—the high arch of Black Snake Ridge, which, at the southern boundary of the property, forms a cover over the coal of two hundred and twenty-five feet—made it impracticable to open at the south.

There are two main openings, one air-drift and two air-shafts to the mine. A steam pump and boiler placed at the bottom of one of the air-shafts to discharge the waters of the mine aid the ventilating current by rarefying the air. The main entry of the mine runs south on the face of the coal, and butt entries are worked in both sides—to the east and west. These entries are four hundred and fifty feet apart, and both main and butt entries are single, and are each nine feet wide. The rooms are started at twelve feet wide, and extended to thirty feet; the pillars of coal between rooms are twelve feet in thickness, and the rooms are opened on both sides of the entries. This mine, like all the other mines of the district, was opened on a faulty plan—the rude, bad plan of taking too much coal and leaving too weak supports in advancing the workings.

During last summer a crush came on and overran part of the first east entry, and threatened irreparable mischief to the main entry itself. The mine superintendent has changed the plan of opening the rooms, with the object of adding extra strength to the entries. Instead of starting all rooms from off the entry, every second room is opened in this way, the alternating rooms being opened in the flanks of the entry rooms. This forms strong rectangular pillars, seventy-four by thirty feet, on both sides of the entry, to oppose any future squeeze.



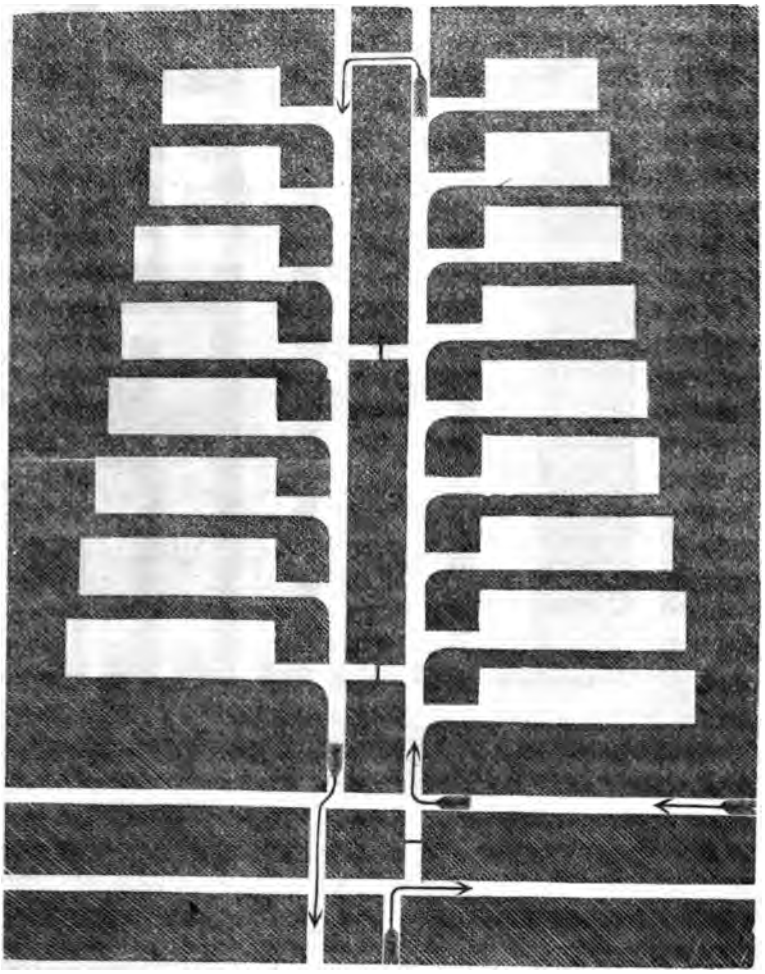
PLAN.

Where there is no air-way in advance, as in the section here shown, the pillars are pierced at the entrance of the double rooms, and doors placed on one side to form a return for the air. Where the mine is laid out in blocks, as in the Hocking Valley, the air flows along the entry to the air-course, thence to the next butt entry above.

A coal-cutting machine was applied in this mine during the fall, the first that has been used in the State. It was taken out to be remodeled in some of its parts, where practice had shown it to be defective.

I have in former reports, and again urge upon all mine superintendents the sure and safe practice of driving double entries to every gallery in a mine, main and butt alike, leaving strong pillars between the galleries.* It adds to the cost in the first stage of working, but it is a saving in the end. No crush can then overrun the entries, and all the pillar coal may be got in working forward, if care and skill are exercised by the manager. Whatever is added to the expense of the mine in driving double galleries is saved tenfold, after the mine is fairly opened out, in the extra yield of coal per acre, while the ventilation is always better. With single entries and small pillars, 40 per cent. of the coal is generally sacrificed in mining.

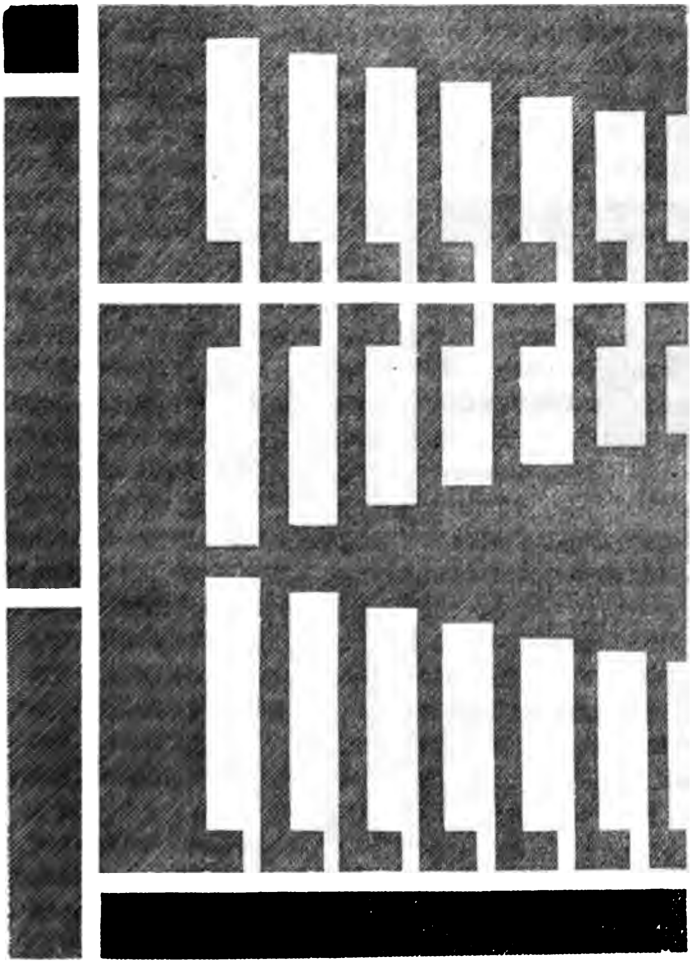
The plan of working by double entry, to which I have so frequently called attention, is shown in the accompanying cut. By this arrangement rooms are never in advance of the air current. If danger is apprehended



DOUBLE-ENTRY WORKING.

from a crush, the pillar between the double entries may be enlarged to suit the conditions, and when the rooms are worked up the pillars can be withdrawn at once

The accompanying cut shows the system or plan of working by single entries. It may be fitly described as the plan of bad air, and of (generally) the ultimate ruin of the mine by the crushing of the pillars. The entry-men, as well as many room-men, no matter if doors are promptly erected, can not have good air. This method of working a mine is happily fast disappearing before more improved plans. Its only recommendation is a little saving in working in the earlier stages of the mine, but this saving is latterly swallowed, besides other costs occasioned by work



SINGLE-ENTRY WORKING.

lost by bad air, by strikes which indirectly result from bad air, and by sinking unnecessary air-shafts and driving unnecessary air-ways. Moreover, a crush or squeeze invariably, sooner or later, overruns the workings, and at best nearly all pillar coal is sacrificed.

Where the coal is of good height, so as to require no blasting of the roof strata to form hauling-roads for the mules, the cost of driving double entries is not greater than the cost of hanging doors to every room so as to get forward air. Where air-courses are driven in the face of the coal from one butt entry to another, as in the Hocking Valley and other regions of the State, it costs the same amount to drive one hundred and twenty-five yards on the face as on the butts.

The Patterson Mine is a new opening, made during the present year. The manager, Col. Youart, opened the first mine in the Straitsville region. He followed the plan in practice in the Hocking Valley of driving single entries, working wide rooms, and leaving weak pillars. As a result, the mine had bad air, and its pillar supports were too weak to protect a crush extending over the main gallery as soon as any of the pillars were withdrawn. In the Patterson Mine, profiting by experince, the manager has laid out the workings on an improved plan, the entries being all double, and the air taken along as the workings progress.

This mine is the best laid out of any in the Straitsville district. The main entry is opened on the butts of the coal, and is about five hundred yards long. One hundred and fifty yards from the entrance of the mine there is an air-shaft seventy feet in depth. From this point the entry is double, the thickness of pillar between the parallels being eighteen feet. A few yards inside of the air-shaft there is a face entry, also double, and having an eighteen-foot pillar between the parallels. The rooms are ten feet wide, the thickness of pillar between rooms being sixteen feet. The rooms will advance from ninety to one hundred yards. This plan makes the mine strong in the first stage of working, and after a series of rooms are worked out, the pillars may be attacked and withdrawn without any fear whatever.

The Straitsville Mine is opened on the face of the coal, the main entry extending northward. Forty yards from the mine-mouth a butt entry is opened to the west. Three hundred yards along this entry another face entry runs north, and parallel with the main or first face entry. There are four butt entries, extending from one face entry to the other, known as butt entries Nos. 1, 2, 3, and 4. From the west, or face entry No. 2, three butt entries extend westward. On the east side of the front or main entry two butt entries extend eastward, both of which are holed through in west entries of the Central Mine.

All these entries are single. As a consequence, reliance is had for ventilation in getting out to day in some ravine with an entry, or in sinking an air-shaft. Two of the three west entries which branch from the second face entry run through the hill, and three air-shafts have been sunk in addition. The mine is ventilated by the natural forces, the air flowing along the galleries of the mine from one opening to another, according to the force and direction of the wind outside. The workmen are employed in two butt entries, one of which is through the hill, and the other has an air-way ahead of the working places, so that the current sweeps past all the working places in the mine.

The rooms of this mine are forty-five feet wide, the pillars eleven feet thick, and the butt entries four hundred and fifty feet apart. This mine was one of the first opened in the Straitsville district. Its numerous day-levels and air-shafts show the rude ideas of mine ventilation prevailing in the early days. If henceforth the practice adopted in the Patterson Mine be applied, there need be but one air-shaft and no day-levels whatever, and there will be a securer mine, fully four thousand more tons of coal per acre recovered, and the ventilation will be better and be always under absolute control. One air-shaft, with a good furnace or fan, can ventilate a mine, if good practice and sound principles are applied, for twenty years of constant work underground.

The Troy Mine has two openings near together, which enter the hill in a south-eastern direction, angling across the face of the coal. One hundred yards from the entrance, the headings turn east on the butts; they are double their whole distance. An air-shaft and furnace are located on the south of the right parallel. A few yards in advance of this point a face entry runs to the south. Another face entry runs north nearly opposite the one on the right. Four hundred feet east of the south face entry a brace of headings, called the Rock Run entries, are pushed far ahead, and will not come to day until they intersect the workings of the Union Mine at Shawnee.

The mine is laid out in blocks, after the method in practice in the Hocking Valley mines, except that the main galleries east and north are double. The blocks are four hundred feet square, nine rooms being in each block. Having double entries where double entries are most needed, and having also a good ventilating furnace, this mine is much better ventilated than any in the Hocking Valley. It has good air. There are five face and four butt entries, counting the double parallels as one. The rooms are thirty feet wide and the pillars fifteen feet thick. With such strong mine supports, there is no danger of a squeeze overrunning the entry until the pillars are attacked and weakened.

The plan of driving single entries, and then driving air-couses from one butt entry to another, is a practice which I can not recommend. Even if the air-courses can be cut through from one entry to another without complaint on the part of the miners, there is danger, in drawing the pillars, of the resulting crush extending over the entry. There can be no danger with double entries, and it costs no more to drive air-headings alongside of the advancing heading than to drive them on the face in the fast. As the blocks are square, four hundred feet each way, the distance is the same whether the entry be driven on the face or the butts of the coal.

The outside arrangements of this mine have been remodeled and greatly improved during the year; a new dump-house being built, a revolving screen and dock elevation erected, and a movable coal-gate applied to the shutes—arrangements which save labor and make better coal.

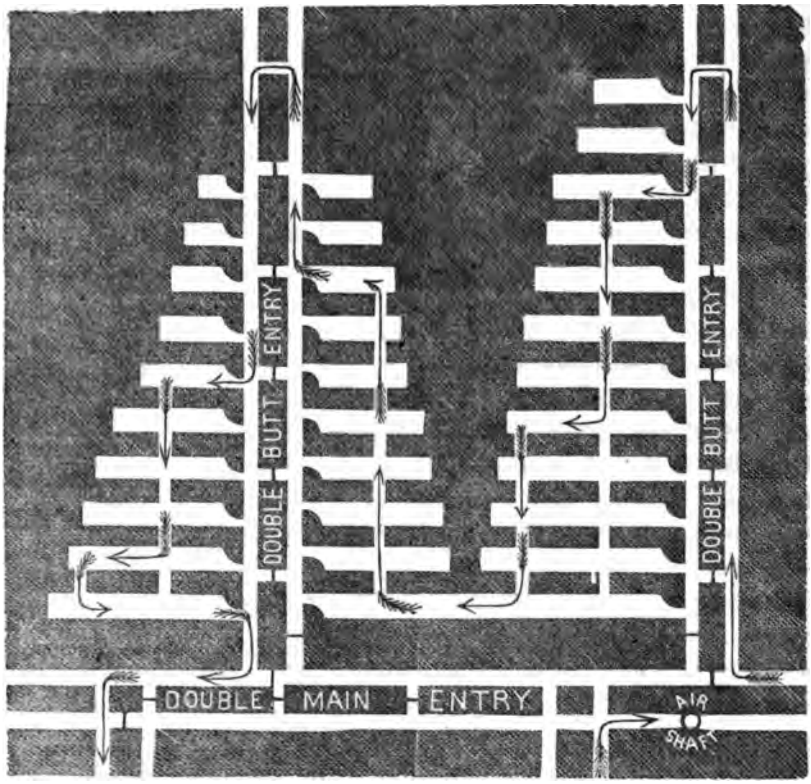
SHAWNEE.

The mines of the Newark Coal Company consist of three main openings, known as No. 1, No. 2, and No. 3. No. 1, the most northerly of the series, enters the hill on the face of the coal, and runs nearly south for one hundred feet, when it wheels to the west and runs on the butts. Four hundred feet from the entrance of the mine, a face entry runs northward. A second butt entry, thirty feet from the first one, is turned west; the rooms from the first butt entry work forward on the north till they hole through. Only every second or third room goes through. These rooms are narrowed to entry width for twenty-four feet before holing in the entry, to add strength to this gallery.

The first butt entry is double; the face entry is also double, the thickness of pillars left between the parallels being thirty feet. The rooms on the second butt entry reach the line of the mineral property.

Mine No. 2 is opened on the butts of the coal, and the entry runs west on a line parallel with butt entries of No. 1. The rooms running north on the main butt entry of No. 2, and the rooms running south on the main butt entry in No. 1, meet in the middle after each range has advanced two hundred and fifty feet from the entry, the distance between the mines being five hundred feet.

The main entry of Mine No. 3 runs north thirteen degrees west, angling a little on the face of the coal. Butt entries are opened on both sides. All these entries are double, and of a uniform width—nine feet. The rooms are started at nine feet, are advanced twenty-one feet in this manner, and are then rapidly widened out to twenty-one feet, the thickness of pillar left between rooms being eighteen feet. When these mines were first opened the entries were all single, the rooms were thirty-six and forty feet wide, and the pillars were only nine and ten feet thick. By the old plan, none of the pillar coal could be recovered, the object being to finish up the mine in the first stage of working. By the present plan, all the pillar coal is sought to be won, and nine-tenths of the whole is won.



PLAN OF WORKING.

In addition to recovering the pillar coal, there is absolute control over the ventilation; the entries are always ahead of the rooms. If cross-cuts are made from one room to another every one hundred feet, and a door hung in the return entry, the air diffuses itself through every working place in the mine. Doors are neglected, on the ground that adequate ventilation can be applied by making the necessary cross-cuts and allowing the air to diffuse at will. Of course, in high and wide working places, more air passes through the workings than in low and narrow ones. Yet, with these natural advantages, we seldom hear complaint of too much air passing, and frequently hear of too little. The loud complaints come, however, from mines in which single-entry work is practiced.

When a range of rooms is finished, the pillars are attacked and withdrawn, the inmost pillars being first removed. The roof of the exhausted area is held up by numerous props, and when a crush occurs the strata fall to the surface. The miners then make a new attack on the pillars, piercing them on the butts, thirty or forty feet below the fall, then facing to the right or left and working forward towards the fall. After removing all the coal, except, perhaps, a small stump to support the roof next to the fall, the miners move their tools and work backward, until a second fall or crush occurs. No crush, however formidable, can overrun the strong pillars, and when the working and rending of the superincumbent rocks show that a crush is imminent it produces no fear. Hundreds of thousands of tons of the vast mass of strata overhead, in the exhausted area, fall down with tremendous force and noise, while the miners in the distant chambers of the mine work on in unconcern.

These mines have two furnaces for ventilation, one in Mine No. 1, and the second in Mine No. 2. The ventilation is generally good, but as the waste-workings increase in extent, the air becomes diffused with the gases formed there, and the miners' lamps burn with a black and cold flame, betraying an impure atmosphere. The intake current of air ought, in all mines where pillars are withdrawn in working forward a mine, to be kept from mixing up, in any manner, with the gases formed in the goaves. If it be necessary to build air-tight stoppings at the edges of the wastes to insure this. it ought to be done. The heaving of the fire-clay floor, resulting from a creep, and the falling of the overhanging strata, resulting from a crush, alike liberate foul and poisonous gases, which mix up with the moving columns of air.

The Shawnee Valley Mines, recently opened, are in good order. The main entry runs south on the face of the coal. This gallery is single until the air-shaft is reached, when it is made double, a pillar of twenty-four feet in thickness being left between the parallels. The butt entries are also double, and are opened on both sides of the main entry—two on the west and four on the east side. The entries are nine feet wide, and are eighty yards apart, rooms working only on one side. The air-shaft of this mine is forty-four feet deep, five and a half feet wide, and has a wooden box on top twenty-four feet high. The furnace is five and a half feet wide and three and a half feet high above the bars. The ventilating arrangements are of first-class order, and a good and pure atmosphere prevails underground.

In the Lyonsdale Mines the entries are eight feet wide, the rooms are started off ten feet wide and advanced thirty, and then rapidly widened out to twenty-four feet, the thickness of pillar between the rooms being twenty feet. The main gallery runs to the east and south, angling across the butts of the coal. This gallery is double, having a massive pillar seventy-five feet in thickness between the parallels. A face entry, near the mouth of the mine, runs south. From this gallery a second butt entry is opened, the southern rooms of which work forward to the line of the mineral property.

This company has a very extensive and valuable coal territory, and the mine is laid out with unusual strength, with the purpose of saving the main galleries until the last of the coal has been opened and won. The various lifts or ranges of workings will be six hundred feet apart, rooms to be opened on both sides of the butt entries and advanced three hundred feet. The pillars may be withdrawn, and, in fact, ought to be withdrawn, as soon as the rooms of each butt entry are wrought forward and finished, the strong twenty-foot pillars being able to resist and break any crush of the overlying rocks.

The arrangements for ventilation now in use in this mine are feeble and temporary, to meet the present requirements of the mine. It is proposed, after the main gallery becomes more extended, to sink an air-shaft in the middle of the pillar between the two parallel headings, and air the mine with two separate and independent columns of air. If this is done, and cross-cuts are made between the rooms every one hundred feet, and a good furnace placed at the bottom of the air-shaft, this mine would soon attain a high reputation for superior ventilation.

The mine of the Furnace Coal Company has two main openings, one on the south side and the other on the north side of the railroad. The workings of both are approaching completion. A proposed new opening, at the end of the railroad, soon to be begun, will enter a large and unbroken coal area. The ventilation in both mines of this company was in good condition.

The mines of the old New York Company are ventilated by the natural forces. There are numerous ravines which cut down through the coal, and the entries are driven through the hill to daylight. All the entries are single, and depend for ventilation on these day-openings. The main part of the mine is now, however, extending underground less broken by erosion, and other means than that which formerly sufficed will be required to give motion to the air. Double entries, the air-shaft, and the rarefying furnace are now needed, and their use can not be longer neglected.

McCune's Mine, two miles west of Shawnee, has several outlets, and is ventilated by the natural forces. The entries are eight feet wide. The rooms are started off at nine feet, and are opened to twenty-one feet (their full width) after advancing eighteen feet from the entry. The main entry is on the face of the coal, and there are two working butt entries, one on each side of the face entry, both of which are driven out to day. The rooms work only on one side, to the north. The pillars are withdrawn as the range of rooms are finished up. All the coal west of Shawnee has become sadly reduced in height. Though the McCunesville coal is the same bed as the Shawnee coal, it only measures four feet six inches, while the Shawnee mines, especially those on the south side of the railroad, measure nine and ten feet. The first symptom of the thinning of the seam shows itself in the mines of the old New York Coal Company, at Shawnee, and the loss of height is caused by a wedge of shale appearing in the coal in the upper of the three benches, splitting it in two—this wedge of shale increasing in thickness, while the bench of coal above it continues to decrease, until finally it disappears forever.

There are four or five other mines opened on the line of the Shawnee Branch of the Baltimore and Ohio Railroad, between Shawnee and New Lexington.

The coal is invariably thin, less than five feet in height, and only the two lower benches are wrought. The force of men employed in these mines is usually quite small, varying from six to twenty hands, and the miners do the digging and hauling. The coal is soft and friable, and yields before the heavy blows of the workmen's picks, so that neither wedges nor powder are used to break it down.

At McCunesville, owing to the rapid fall of Munday Creek, and the rise of the strata to the south and west, the coal is one hundred and fifty feet above the level of the railroad. Three seams are exposed below the great seam, or No. 6; but they are each too thin to be of any immediate commercial value. The first bed in descending order, No. 5, about twenty feet below the great seam, is twenty-six inches in thickness, and has been opened or laid bare at several points. About sixty feet below the great seam the second bed, No. 4, exposes itself, and is also a bed of coal from two feet to twenty-six inches in height. The third coal, No. 3, is level with the creek, and is capped with a blue limestone roof. This coal is irregular in thickness, varying from a few inches to two and one-half feet.

The Diamond Mine, located at Bristol Tunnel, works a small force of men, the miners digging and hauling the coal. There are two mines, one on each side of the railroad. The south mine has been opened up within a few months, and was working only five men at the date of inspection, in September last. The north mine has been in operation for several years, and usually employs fifteen to twenty-five men. The main entry is ten feet wide and has a double track, and runs north on the face of the coal. The butt entries, four in number, run east, the line of the mining property lying within one hundred feet of the main entry, and running nearly parallel with it. Rooms are worked on one side of the butt entries, to the north, and these entries are only fifty yards apart. The rooms are made fourteen feet wide, and started off the entry at six feet. Only the two lower benches of the coal are mined, the working height hardly exceeding three feet. An air-shaft is located at the end of the second butt entry; but there are no doors or other arrangements to direct the air round the mine. I advised the location of a door at the entrance of the lower working butt entry to force the air to the upper one, as the air there was none too good.

Within the present year three blast furnaces have been built in this coal region—two at Shawnee and one at Gore—and they will soon be followed by others. The Fanny Furnace at Shawnee blew in on Friday morning, September 15th, and made her first "cast" Saturday. The ore is native ore, got at Iron Point, two miles north of the furnace, on a horizon twenty-eight feet above the limestone ore, and immediately underlying the four-foot coal, No. 7, the ore bed ranging from one to two and a half feet in thickness.

The coal used in the Fanny Furnace is taken from the mines of the Shawnee Valley Coal Company, and applied in a raw state, with the addition of a little Connelsville coke. The limestones are also quarried on the mining property of the company. All the elements for the successful manufacture of iron extend through every hill in this coal region, as well as through the counties of Athens, Vinton, Gallia, Jackson, Scioto, and Lawrence.

MUSKINGUM VALLEY.

The Del Carbo Mines are situated on George's Creek, and are reached by a branch road two miles in length, leading from Del Carbo Station to the mines. Two seams of coal have been opened, the equivalents of Nos. 5 and 6. The upper seam, which is three and a half to four feet high, is not worked at present. The lower bed—a coal from four to five feet in thickness—has a very fragile roof. The entries are seven feet wide; rooms eighteen feet, with nine-foot pillars. The butt entries are only sixty yards apart, and rooms are worked off both sides, thirty yards being the destination of rooms. The roof is a light, soft, and loose shale. Eight inches above the coal another thin band of coal appears, then follow in ascending order light shales from eight to twelve feet. This material, when subject to the influence of the air, readily falls down, and the entries are in some places ten and twelve feet high. The mine is ventilated by the natural forces, there being an air-shaft thirty-six feet in depth sunk toward the back of the workings. The ventilation, however, at the working faces was not good, for want of the necessary air-passages, and other arrangements for leading forward the too feeble ventilating current. There were neither doors nor stoppings in the mine.

Owing to the natural disadvantage of roof in this mine, it would be both economy and increased security to drive to the back of the butt entries before opening rooms. It would be a still better plan to work the mine on the long-wall method—working backward. By the present plan increased expense is incurred driving entries, and more than one-half of the coal is finally lost in abandoned pillars. The coal is of unusual purity and excellence, and it does not appear to occupy a very extended area, being disposed in basins or troughs, after the manner of the coal of the Mahoning Valley region.

At Zanesville and vicinity numerous openings are made in the equivalents of the two seams of the Del Carbo coal. The mines are, however, generally worked on a small scale, and do not come under the requirements of the mining law. These mines have all more than one means of ingress and egress, but they are rudely worked, and little or no attention is given to the ventilation. During the past summer many of them had become so foul with bad air that the working places of the miners could not be entered for several days at a stretch.

The Muskingum Valley region—by which is meant the mines on the Muskingum Valley road, between New Lexington and Zanesville, and also those on the Muskingum River—employs miners to do the digging and hauling both, the workmen being assisted in hauling by massive dogs. The coal is usually not more than three and a half feet high, and in the butt entries no roof is taken down. Where mines are of limited extent, and the force of men employed are few, a saving is had to the mine owners by this system of working. It is a practice, however, very injurious to the constitutions of the miners during the winter months, as coming out of the mines a dozen times in a day from a temperature of fifty degrees to one often below zero, with no clothing but a thin shirt and pair of pants, they contract colds which too frequently end in consumption. The miners of this district are too much in the habit of wearing cotton clothing while at work in the mines. They ought to change this garb, and adopt one of wool. This is the experience of miners in the older mining districts of the State and Nation, as well as that of the oldest European countries.

MAHONING VALLEY.

Curtis Hill Mine is situate near the Pennsylvania State line, on the Shenango River, and just opposite the village of Sharon. This mine is the oldest in Trumbull county, having been opened in the year 1843. It is a drift opening, the only water-level mine in the Mahoning Valley region. The lines of travel, from the entrance of the mine to the interior of the workings, are two and one-fourth miles in length, and fifteen mules are employed hauling coal from the miners to the chutes. The coal lies in two basins, which occupy nearly parallel lines, but there appears to be no connection between them. In the earlier days of working the mine the existence of the northern basin was unknown, but after the workings of the southern basin began to threaten exhaustion, the territory north of this swamp was bored, and coal was found of good quality and thickness.

The main gallery of the first opening is nearly a mile long. It then passes through the hill, in a day-level, thence runs outside one thousand yards up the ravine and reënters the same hill, tapping the northern swamp. In the old mine the miners worked forward toward the west, but in the new mine they are working backward toward the east, on nearly parallel lines. The working faces of the mines, which, by the lines of entry-travel, are two and one-fourth miles from the entrance of the main gallery, are less than one mile in a direct line. Of the fifteen mules and drivers engaged in hauling cars, two-thirds of them are employed on the road between the first and second openings. A small mine locomotive would be a labor-saving machine to this company.

The interior of the mine was in good order. A good current of air flowed through the mine, and was well distributed through the working places of the miners. The plan of working consists in driving butt entries every seventy yards, and working rooms on one side only. Air-courses are driven from one butt entry to another every sixty or seventy yards, and until each air-course is through a brattice of wood is taken alongside of the entry to move forward the air. These arrangements do away with the necessity of doors in rooms, and so the wind, instead of leaking and spilling at every door, moves forward in a full stream. Owing to the many eccentricities of the coal seam, this plan can not always be followed to the letter, and modifications are made to suit the varying conditions. The rooms of the mine are made nine yards wide, with three-yard pillars between them. Where the roof is good rooms are started off at four yards in width. The roads are taken up on one side of the rooms, and the pillars are withdrawn.

The Brookfield Slope is situate two and one-fourth miles south-west of the Curtis Hill Mine. This is a very extensive mine, and has been working for fourteen or fifteen years. The slope was, unfortunately, located on the rise end of the basin, and the main swamp entry has constantly dipped as it advanced, till now, at the face of the workings, the entry is thirty-seven feet lower in the swamp than it is at the bottom of the slope, the distance being one thousand three hundred yards, and the general line of direction south-west. This circumstance has necessitated a great outlay of money—cutting drains, sinking shafts, and applying pumping machinery to discharge the water from the dip workings. Had the slope been opened at the low end of the swamp the water would have flowed to the bottom of its own accord.

The mine is situate one mile west of the Shenango River, three hundred feet above the level of that stream, and is reached by an inclined plane half a mile in length, and by a tram-road, also half a mile long, which extends from the top of the plane to the mouth of the slope. The face of the main gallery of the mine, under ground, is six hundred yards west of the top of the incline plane, the tram-road and swamp entry running on nearly parallel lines from opposite directions. A tunnel is now in progress, beginning at the foot of the incline plane, and advancing in a horizontal direction, in a due west course, in the Waverly sandstone underlying the coal strata, to intersect the face of the swamp entry.

At the time of inspection of this mine, September 27, this tunnel had been advanced one thousand yards from its entrance at the foot of the incline plane, and a force of men were also at work in the mine, at the face of the Scotch entry, driving outward. The two parties were one hundred and fifty yards apart, and the work will be completed before this report goes to press. This tunnel will do away with the slope and all its machinery, with a large pump at the bottom of the air-shaft, and two hand-pumps, with the tram-road on top, and with the incline plane, and thus reduce the daily cost of getting the coal at least thirty dollars per day.

The tunnel is made eight feet inside, and six feet high, and has a gradual rise from its mouth of two feet to the one hundred feet. The work goes on day and night, the force of men being nineteen in all. The tunnel was commenced in April, 1875, and has averaged sixty yards per month. The rock is bored by one of Rand & Warring's drill and compressor engines, the steam and air cylinders being each eight-inch diameter. The drills are Randolph's patent, and the bits one and one-half inch diameter. Four undermining holes, two top holes, and two bottom holes are drilled and fired at once, the explosive agent being daulin. The holes are usually five feet in length. The compressed air is discharged among the smoke after the explosion, and the mine is clear in a few seconds. The ventilating apparatus consists of a wooden box sixteen by twenty-one inches, the air entering by the tunnel-mouth and returning through this box. An air-shaft, with a ventilating furnace, rarefies the air.

The Waverly sandstone through which the tunnel passes consists of alternating layers of shale and sandstone, each from three inches to one foot thick. This is the bottom rock of the coal drillers, and lies immediately under the conglomerate, when that rock is present. When it is absent, a few feet of shale usually separates the coal from the Waverly. The dip of the strata in the tunnel is south-east, and is quite marked.

Though the tunnel is only eight feet wide, usually less, at the roof, the shales and sandstones alike keep falling in fragments, till, in some places, the roof is eight to ten feet high. When first excavated, the roofing stands firm, and rings hard and compact, but time and exposure to the air cause it to loosen and fall in fragments. On this account the tunnel will require to be timbered the whole length of the way. A little fire-damp has been met in blowers (but nothing to alarm the miners), in the vertical cleavages of the rocks.

This work was proposed by Mr. Buell, the general manager of the coal company; was surveyed by Mr. Read, of Youngstown; the mine manager is John Jones, and the foreman in charge of the hands in the tunnel is Reese Harris. No accidents of any kind, except that one of the workmen was once injured by a fragment of rock falling on him while filling a car, which laid him off work for seven weeks.

The manner of working the coal in the Brookfield Slope consists of driving the butt entries two hundred yards apart, and working rooms on both sides. The rooms are made four yards wide at their entrance, and are extended to seven yards; the thickness of pillar is five yards, and the length of same seven yards. Openings or cross-cuts are made from one room to another every seven yards, but the pillars are formed in alternating blocks, like the squares of a draught-board. There is a strong current of air in the mine, rarefication being caused by two twenty-four-feet boilers placed at the bottom of the air-shaft to make steam for the water-pump. A drill-hole near the boilers, through which a stream of pure water flows, is used for feeding the boilers, the mine water being largely impregnated with coperas, and unfit for use.

The air-doors of the mine, and all the other ventilating arrangements, are well maintained, and the mine is in good condition. All the doors are so hung that they shut of their own accord, and can not stand open.

Mr. Thomas Bowen, now working in the Brookfield Slope, was, together with three comrades, inclosed in a mine at Coalburg, Trumbull county, from 2 o'clock on Friday afternoon, July 21, 1865, to Thursday, 6 o'clock P.M. of the following week, two of the miners not getting out till Saturday, the ninth day.

The mine was a slope opening, and the coal strata were disposed in a long, narrow, and serpentine trough or swamp. On both sides of the swamp the coal rose rapidly, so that the higher workings were twenty to twenty-five feet above the level of the swamp. The mouth of the slope stood facing a small rivulet, the waters of which, even during the fiercest storms of former years, had rolled harmlessly past. About noon of July 21, however, a storm unparalleled in fury occurred. The rain came down in torrents, the water overflowed the banks of the creek, and towards evening rushed tumultuously down the slope. The main gallery of the mine was filled to the roof, and the water nearly filled the slope. Only the very highest workings in the interior of the mine were dry.

Two of the miners were on one side of the swamp, and two on the other. They worked on unaware of their danger, when, attracted by the rise of the rushing water, they started to go out to see what was the matter. By this time the main gallery was full to the roof, and they had to retreat before the advancing waters. The parties on the opposite hills hallooed to each other, and made their voices heard, but could not understand what each other said. The increasing volume of water drove each party back up the opposite hills until only the higher galleries were left dry.

The news of the catastrophe spread like wild-fire, and all the mines in the Mahoning and Shenango valleys (twenty-five in number) stopped working, and the miners rushed to the rescue of their imperriled fellows. The pumps of the mine were drowned, but the miners stretched themselves in lines along the slope, and began bailing out the water. They worked with herculean energy, and the water fell rapidly in the slope.

Meanwhile, a bore-hole was commenced on the line of the high workings, with the purpose of sending down food to the imprisoned men. The hole came down in a pillar, but within two feet of the workings. It was now Monday, and the foul air of the mine had put out the lamps of the miners. They cut in the pillar-side in the dark, and reached the drill-hole. The people on top sent down crackers, which were washed away by the water in the drill-hole, and seized by rats, hundreds of which sought safety with the miners in the high workings. Beef tea, and soup, and brandy were next let down in long, narrow bottles. The food was eaten by the miners, but the brandy was too strong, and they could not drink it.

By six o'clock Thursday Bowen and his comrade were reached and rescued. The two miners on the opposite hill were still beyond help, but were reached and rescued on the morning of Saturday.

In the fall of 1875, as stated in my last annual report, complaint was made against the Niles Coal Company, the Church Hill Coal Company, and the Mahoning Coal Company, for failure or refusal to comply with the mining law. The Halliday Mine was also complained against about the same time. I did not desire to apply the remedy of injunction, except as a last resort, and so instructed the attorneys, Messrs. Taylor and Jones, not to apply for a temporary injunction, but to have the cases set for trial in their regular order, hoping the mine owners would comply with the law before the cases were reached. The suits against the Halliday Bank, the Niles Shaft, and the Church Hill Slope came up in the February court, but at that time a bill was pending in the Legislature remodeling the mining law, the passage of which would have given an extension of six months to mine owners from the date of passage before the law in the cases of the mines complained against would have taken effect. I therefore requested the attorneys to continue the suits.

I visited the Church Hill Slope and the Niles Shaft during the summer, to see whether any improvemgnt had been made, and finding defective ventilation still prevailing, sent the following communication to the superintendent of these mines:

OFFICE OF STATE INSPECTOR OF MINES,
COLUMBUS, OHIO, *August* 1, 1876.

G. M. DILL, ESQ., *Superintendent Church Hill Coal Company:*

SIR: I waited for you at Church Hill till noon on Thursday last, in accordance with your request, in order to take you through the mine and show you the places where defective air was prevailing, but for some reason known to yourself you failed to come.

My purpose in inspecting the mine at the time was to discontinue legal proceedings against the Church Hill Company if the mine were now thoroughly ventilated as the law directs. There were a number of places in the mine where the ventilation was very defective, and believing it would be to your interest to ventilate them, I was very glad to hear you propose to accompany me, as then you would be satisfied by ocular proof of the condition of the mine. In every entry I was in, and in a number of rooms near the entry faces, the mine atmosphere was thick and close. There were no means of discharging the air in these working places, and consequently there could not be proper ventilation prevailing. There was plenty of air passing through the galleries and air-ways of the mine, but before it came to the places I have mentioned it stopped and returned to the air-shaft, and for all the practical purposes of ventilation, so far as those places were concerned, might as well not have entered the mine at all.

A few dollars a month are saved by refusal or neglect to drive air-courses and hang doors, but what is saved to the company is saved at the expense of the health and comfort of the miners, and in violation of the law, and is ultimately lost one hundred fold in the strikes which have their origin in the foul air of the mine.

A bad state of ventilation prevails in some working places I visited at the extremity of the mine, the result of gross negligence. Air-courses which must of necessity be driven are neglected until the lights will no longer burn, and then the air-courses, instead of being pushed forward to the faces of the workings, are kept far in the rear, as if the air was given grudgingly.

I will add, in justice to all parties, that the mine is now in better order in its general ventilating arrangements than I have ever seen it, but it still needs improvement at the entry faces and the interior rooms. I have no wish to have any suit with your firm, but I shall insist on every working place being thoroughly ventilated as the condition on which legal proceedings will be discontinued.

Very truly yours,

ANDREW ROY, *Mine Inspector.*

OFFICE OF STATE INSPECTOR OF MINES,
COLUMBUS, OHIO, *August* 1, 1876.

EVAN MORRIS, ESQ., *Superintendent Niles Coal Company :*

SIR: On the 26th and 27th ult. I made an inspection of the Niles Company's shaft, near Church Hill, with the object of discontinuing legal proceedings against the Company if I found the mine ventilated and in a fit state for men to work in, as the law contemplates. I regret being required to state to you that the mine is still imperfectly ventilated, and the suit will not be withdrawn, unless some marked changes are made in the ventilation.

On the 26th the air was very bad all over the mine, and a number of the miners were obliged to leave work and go home. The mine boss informed me the fan had not run any the previous night, owing to the belt breaking, and that if I would come back on the 27th I would find every thing satisfactory. I agreed to this suggestion. While finding the air much clearer the next day, there were still a large number of working places in a very defective condition and unfit for men to work in.

In Dagan's entry, the two entrymen and one room-man outside had bad air, and the smoke from the workmen's lamps and bodies made these places so hot and vapid that the temperature was sixty-four degrees of Fahrenheit, whereas the temperature of the mine where the air was pure was only fifty-two degrees. The miners' lamps burned with a dull, sickly flame, and there was not a mouthful of fresh air to be had. Severa of the rooms outside of these places, although holed from one to the other, and having doors placed at their entrances, were not above complaint, the air leaking and losing further outside.

In the Centennial entry an equally bad condition of the atmosphere was found.

In T. P. Jones's entry there were five men ahead of the air, and they were all plunged in a deleterious atmosphere.

In the Colorado entry every working place had bad air, the inmost rooms being very bad. The temperature was sixty-four degrees there also.

I measured the amount of air flowing through the slope, and by no calculation of mine can I make more than seven thousand cubic feet per minute, not two-thirds of the column required by law.

It remains with you to decide whether legal proceedings shall go on or not. If the ventilation is improved as the law requires and the sanitary condition of the mine demands, I have no wish, as I have no power, to interfere, but the law must be obeyed.

Very respectfully,

ANDREW ROY, *Mine Inspector.*

On visiting this region in July, a new opening, the Centennial Shaft, had reached coal, and was employing a force of fifteen to seventeen men. The shaft was sunk at the northern end of the workings of the Church Hill Slope, going down into one of the rooms of that mine. The shaft had neither safety-gates, safety-catches, nor covers on cages, and the rope looked to me as being unsafe. I therefore sent the following letter to the superintendent of the mine:

> OFFICE OF STATE INSPECTOR OF MINES,
> COLUMBUS, *August* 2, 1876.
>
> EVAN MORRIS, ESQ.: *Sir*—I examined the mine and machinery of the Centennial Shaft, at Church Hill, on the 26th ult., and do not regard the wire rope used for raising and lowering the miners as a safe one. I also noted that neither safety-gates, safety-catches, nor covers for cages were applied. I was about to proceed to Warren on the 28th ult. to petition court for an injunction to enjoin or restrain you from working the mine with more than ten men at once until the law was complied with, when Mr. Thomas, the pit boss, informed me you had been at the mine the evening previous, and had left orders to have these appliances provided at once. I hope you will also give the rope a careful test, for I can not regard it as a safe one.
>
> Yours very truly,
> ANDREW ROY, *State Mine Inspector.*

Replies were sent me to each of the foregoing communications, which promised that such improvements should be made in the ventilation as would remove all cause for complaint. I have, however, not withdrawn the suits, and they have been set for trial in the October court, but will not be reached before the end of November. I shall make another visit and inspection of the mines before the cases come up for trial, and if all cause of complaint has been removed, legal proceedings will be discontinued. If, however, no improvement has been made, the remedy of injunction will be insisted upon until the law is enforced and obeyed.

The Mineral Ridge mines have done little work during the past three years, the best of them averaging less than three days per week, and some have been closed altogether. The coal is thinner and more easily mined than the block coal mines, and is also of inferior quality for every purpose. The blackband ore associated with the coal, and mined with it, compensates in some degree, however, for other natural disadvantages.

The Osborn Slope, a work opened within eighteen months, was running steady at the last visit to this region, employing seventy to eighty men. The coal area was quite limited, and the miners were working three and four in a single room. The rooms are worked eight to ten yards wide, with pillars six feet thick and twelve feet long between them. One of the entries had defective ventilation, but was nearly holed through on the Tod and Wells shaft.

The Cambria Mine had recently changed hands (September 27), was working a good force of men, and running steady. There was a good flow of air along the air-gallery, but up at the working faces, where the people were employed, particularly in one of the butt entries, there was no air at all. The entry had been advanced away in the fast, and a dozen men were working ahead of the air. An air-course was in progress from the butt entry further ahead, but there was still a month's work before it would be got through. The present owners were not responsible for this condition of affairs, having had the mine only a few weeks. This mine has one face entry running northward on the rise of the coal strata, and four butt entries extending eastward. These butt entries are designed to be one hundred yards apart. The rooms are made nine and ten yards wide, working off both sides of the entry. The pillars are six feet thick.

Three mines to the north of this shaft, namely, the Old Shaft, the Peacock Bank, and the Morris & Price Slope, whose workings have been abandoned, discharge their waters into the Cambria. At the bottom of the pit there is a Keystone steam pump, with eighteen-inch cylinder and twelve-inch water barrel.

The Austin mines (Tod and Wells shaft) is one of the oldest and most extensive of the Mineral Ridge mines. The main entry runs south-west on the face of the coal. Butt entries work on both sides, are usually one hundred and forty yards apart, and extend boldly forward. The hills are seldom more than a few feet in height, and are cut down after they are passed over. There are four entries running to the south-east, and five running north-west. The rooms are ten yards wide. The thickness of pillar is six feet.

The Weathersfield Shaft and the Ashland Slope were idle at the date of visit to this region. There were complaints of bad air in both. They do not run more than six to ten days a month, and during idle time the ventilating furnaces are not kept up, hence the mines become filled with foul air. The Ashland Slope is nearly wrought out, and its workings are through on the Cambria Mine, the Morris & Price Slope, and the Austin mines, the foul air from whose old works pollutes the mine atmosphere, unless the circulation is constantly renewed, and this is not done. Were the coal trade in a healthy condition, and the mines running steadily, I should be obliged to resort to the remedy of injunction to get the ventilation improved, as the law directs, in several of the mines of this neighborhood. Since the panic set in there has been no trade of any account, and when work is done every possible expense is cut down to make the mines clear expenses. Air-courses are neglected, roads are neglected, and each day's work is done as if it were the last day of the mine. The miners, who do not work more than two to three days a week, pass their short working hours in an atmosphere unfit for the abode of man.

TUSCARAWAS VALLEY.

The mines of Summit county visited and inspected during the year were the Summit Shaft, Spicer's Mine, Brewster Brothers' Slope, and the slope of the Brewster Coal Company. This latter mine was idle on the day of inspection, and was not as thoroughly examined as it would otherwise have been. It had a fair state of ventilation, except in one or two places, and on calling the attention of the boss to the fact he stated that the rooms in question were passing under the tram-road leading from the mines to the chutes, and that he did not wish to make break-troughs or cross-cuts for air, because it was deemed necessary to keep this part of the mine strong.

The Summit Shaft was not in as good condition in its ventilating arrangements as I had formerly found it. The mine had been doing very little work, and was not as well attended to as it was during brisk work. The mine has always borne a high reputation for its superior ventilation, and the company, when the mining law went into operation, cut a traveling way from the top of the ground to the bottom of the mine for the ingress and egress of the miners. During the winter the ventilating furnace was not kept up, in order to prevent the formation of ice in the hoisting shaft.

The slope mine of the Brewster Brothers was also not in good order, so far as a pure atmosphere was concerned. This mine, which usually has a working force of twenty-five to thirty miners, is holed through on the drift mine of the Brewster Coal Company. When the drift mine is working and the ventilating furnace kept burning, the slope of Brewster Bros. receives its air from the drift mine of the Brewster Coal Company, and a fair state of the mine atmosphere prevails; but when the drift is idle and the furnace is out, the foul air from the waste workings of the drift is drawn out into the slope workings and pollutes the atmosphere of the mine. As the openings between these mines are very numerous, and many of the old rooms have fallen in, there is no way to isolate the foul air from the Brewster Bros. slope.

Spicer's Mine is a new work, and will never be extensive, being opened on a knoll containing an isolated track of coal. Thirteen men were at work in the mine at the date of visit, January last. An air-shaft had already been provided, and the ventilation was good. This mine is also a slope opening. Only one room entry had been opened, near the bottom of the slope.

The Wadsworth Mine was in good order, and had an abundant flow of air. On the first butt entry, near the bottom of the slope, the air-shaft is sunk, and a powerful ventilating furnace, well kept up, stands at the bottom of the shaft. This entry is one of the main hauling-roads of the mine, and the ventilating current returns through it direct to the furnace. When the drivers pass, and when they are waiting for their trips at the bottom of the slope, they throw coal in the furnace, so that it is never allowed to go down during the working hours of the day.

In the Diamond Mine of Humphrey & Coleman, as well as in many other mines, the air-shaft and furnace are in a remote part of the mine, and the furnace is never visited, unless when it is supposed to need renewing. As a result, the fire in these mines is oftener nearly out than otherwise, the air-current is feeble, and the men at the working faces are complaining of the foulness of the air.

A horseback, consisting of a mass of sandstone, came from the roof in the main entry of the Wadsworth Mine last spring, and cut the coal down to six or eight inches; but good coal was known to be beyond the fault, and a stone entry cut through it rewarded the adventure with a new field.

The Maple Grove Mine was formerly a shaft, but the shaft was abandoned, and the coal brought up through a gently dipping slope. The main entry of the mine, following the swamp, has a general northern course. Five general butt entries are opened, exclusive of the first right entry, which, bending to the south, becomes an extension of the main swamp. The butt entries are all in local swamps, which spread out from the main swamp like the branches of a tree. Though they are depressions in the coal floor, these swamps continue rising, the coal gradually losing height as it emerges from the swamp, until the white roof is reached on the east and a sand-bar on the west, which form the flanks of the coal area. There are numerous horsebacks—rolls in the roof, and sometimes in the floor, from three to fifteen feet in thickness—which render it necessary to work some of the rooms on the butts.

The rooms are made nine yards wide, with pillars two to three yards in thickness between them. The workings of this mine have been greatly improved in their ventilation during the present year, and miners are now grateful who were formerly fault-finding.

At this Maple Grove Mine, in Stark county, a coal-washing apparatus has been erected within a few months for washing nut coal and pea coal as they pass through the screens. The plan is simple, and costs but little, consisting of two sets of troughs (one for receiving the nut, the other for the pea), which pass under the screens. The water of the mine is collected into a reservoir, thence let out through a three and a half inch diameter gas-pipe into the troughs, carrying the coal along, while the dirt, slate and sulphur, which are heavier than the coal, settle by the way in the bottom of the troughs. There is not height enough at the chutes to dump the cleaned coal into the cars, but mines more favorably situated can have this arrangement. The water of the mine also is not of sufficient volume to serve the purpose required, and has to be used over several times, being pumped back from a second reservoir into the first one. The nut and pea coals of this mine, freed from all their impurities by the process described, are in active demand in the market, and command three dollars more per car than that ordinarily produced.

The Burton Shaft is a new mine, opened within the past two years, and the workings are near the bottom of the pit. The entries, main and butt alike, are double, the thickness of pillar between the parallels being from two and a half to three yards. The rooms are started at nine feet wide, and extend twenty-seven feet; pillars six feet thick are left between rooms. The main entry goes north on the face and rise of the coal. The butt entries are from one hundred to one hundred and fifty yards apart.

The ventilation is produced by means of the exhaust steam from a pump at the bottom of the pit. As the mine does not make much water, the pump is not run during the night, and the flow of air (too feeble even for a new mine when the pump is running) ceases during the night. The air-courses between rooms are also too narrow, and the result is much complaining on the part of the miners for fresh air.

Within a few months a second opening was provided, in accordance with law. It is used only as an escape shaft, and serves no purpose whatever for ventilation. The cage of the mine has a safety-catch applied, but I could not approve of it, and desired the boss to test it and send me the result. There is no cover on the cage. I have notified the owner several times of neglect on his part to comply with the requirements of the mining law, and have recently notified him that I would soon apply to court for an injunction to stop the mine from working with more than ten men at once, unless the law is complied with.

Williamson's Mine has neither furnace nor other ventilating power; the cage has no cover, no safety-catch, and the top of the shaft no proper safety-gate. No improvement has been made in this mine since the law went into operation. During the summer defective ventilation prevailed. This mine has been complained against, and an injunction asked for to restrain the owner from working more than ten men at once until the law is complied with.

The Aberdare Shaft has all the appliances required by law, with a goood column of air in motion, though formerly the air was not distributed through the workings as the law directs. The shaft was unfortunately located at the high end of the swamp, and the main gallery dipped all the way from the pit-bottom, adding to the cost of hauling and digging. The ventilation was formerly very defective in this mine, but it has been improved of late. There is, as I have said, plenty of fresh air in the pit, and if it is properly distributed there will be no cause for complaint.

The Diamond Mine of Humphrey & Coleman, situate in Wadsworth township, Medina county, was visited three times during this year, and five times in 1875. Its workings were approaching an abandoned shaft filled with water, and the miners were in constant alarm lest the workings of the abandoned mine should be holed through upon, endangering their lives by drowning. Last winter, however, the entry (No. 8) which was approaching the old mine encountered thin coal, and was stopped, and no advance has been made on the water since that time.

This mine has never been well ventilated, and the miners have complained to me every few months. I have urged the mine boss and the mine owner to give increased attention to the air, and improvement has repeatedly been made; but when made, a season of neglect followed, until the mine was as bad as ever. The mine-owners think the miners are unreasonable in their complaints, and allege that the workmen make these complaints with the object of getting the boss turned off. The repeated inspections of this mine have satisfied me that the miners are justified in complaining—that there is inexcusable neglect in getting forward air, and in keeping up the furnace. I have never visited this mine without finding the ventilating furnace nearly out, and no furnace man about. Doors were also leaking air, so that when you got to the working places, where the people needed air, it had nearly all leaked by the way. On my last visit I endeavored to measure the amount of current passing along the main air-course of the mine, but there was not enough to move the anemometer. Gunpowder was flashed, and the time noted it took to move the smoke along twenty feet of air-course, and instead of 3,500 feet, there was not 300 feet per minute. The column of air coming down the slope had leaked by the way at every faulty door and stopping, like a bucket full of water at the well leaking in fifty places, and becoming empty before reaching the house.

This mine is now the only one in the Tuscarawas Valley that has single entries, and relies for air on trap-doors. Were unceasing vigilance exercised, it were possible, but only possible, to keep the mine above complaint; but when there is constant neglect, there can not but be bad air, and men can not but complain.

The Silver Creek mines, two in number, are situate in Wayne county; one is level free and the other a shaft. Both are ventilated by furnace power, have double entries, and are generally well ventilated. The main gallery of the drift runs a little east of north till it strikes the eastern boundary of the coal deposit, thence it changes to west of north for about one hundred and fifty yards, thence wheels on the same line of direction on which it first started till it strikes a horseback, four hundred and sixty yards from the mouth of the mine. All the coal outside of this horseback has been worked out, and this part of the mine is abandoned. The horseback is four hundred yards in thickness, consisting merely of sandstone, through which the entry had to be cut. Inside of the horseback the main entry branches off to the right and left to the boundary of the basin, and opens up the mine anew. All the entries are double, and the air flows along in a good current, sweeping the mine and renewing the circulation.

The workings of the shaft are laid off with more taste than those of the slope, owing to the natural advantages favoring this mine. Face entries extend north and south of the pit bottom, and butt entries open on each side. Several of the butt entries have been worked out on both sides of the pit. The butt entries are laid out every hundred and fifty yards, rooms working off both sides and meeting in the middle. There are numerous troubles running through the coal, consisting of rolls in the roof. They are invariably composed of sandstone. On the boundary or flank of the coal basin these rolls sometimes cut the coal out before it begins to rise on the hill.

Bartges's Mine is in Summit county, and runs only during the spring, summer, and fall, all the coal being shipped by canal. The mine is level free, and is ventilated by a furnace placed at the bottom of an air-shaft. The force of men usually employed is less than forty, and the mine is not very extensive. The workings are extra well ventilated; the current of air, ample for the requirements of the mine, is carried forward to the working-places of the miners, and keeps them cool and clean. All the entries are double. I have found at this mine, what I have found in numerous other mines in the State, that the men were grateful and proud of the condition of the air, and instead of complaint, all united in speaking in high praise of the condition of the mine.

REMARKS ON VENTILATION.

Properly constructed furnaces, well maintained, and spacious air-passages carried forward towards the working-places of the miners, will cause an abundant flow of air through the many ramifications of a mine. The furnace should be placed at the bottom, never at the top, of an upcast shaft, no matter how limited the requirements of a mine may be. Deep shafts move more air than shallow ones, with the same furnace power, as the deeper the shaft the longer the column of hot ascending air. The practical power of the furnace is in proportion to the depth of the shaft, the power being as the ratio of the depth. The furnace should be set back from the bottom of the up-cast shaft fifty or one hundred feet, or even one hundred and fifty feet, if it can be done to advantage, as then the danger is avoided of setting the wood work of the shaft on fire. If there is danger of firing the wooden fixtures in an up-cast pit, the wood ought to be forthwith removed and the shaft lined with incombustible material instead. Numerous cases could be cited of destructive and fatal mining catastrophes caused by the furnace setting the wood lining in an up-cast on fire, of which the Avondale catastrophe in Pennsylvania and the Atwater catastrophe in Ohio are occurrences of recent years.

Many of the ventilating furnaces in the State are too small for good results, the air being too confined in passing through. Roomy air-passages and a small furnace are of little avail. An amusing instance of this practice occurred on the occasion of a visit to a mine in the Mahoning Valley, while Mining Commissioner, five years ago. The furnace was a very small one, and only about two thousand feet of air could be moved by it. It was set back from the mouth of the up-cast twenty to thirty feet, and the coal for supplying it was mined from the pillar near the furnace. After a time this place was holed through on the bottom of the air-shaft. The column of air then increased in volume to four thousand cubic feet per minute. The boss was astonished at the result, and imagined that he had made a discovery in ventilation, and even seriously thought of applying for a patent on the discovery. I told him that his furnace was too small to admit the air through it that now found escape through the new opening, and his plan was not to apply for a patent, but to pull down his furnace, and in its stead erect one more roomy, and he would behold still better results.

One intake and one discharge opening are all that are necessary to ventilate a mine well. Where the main opening is a day-level, as in drift mines, the discharge air-opening should invariably be a shaft, and the deeper the shaft the better. It matters little where the air-shaft may be located, so that it has depth, and the air-course has width ; a good furnace or fan will then give motion to the necessary quantity of air to ventilate the mine as the law requires. But the air must be carried around the working places where the people are employed. To do this roomy air-courses must be driven and doors and stoppings promptly provided, or the wind will take the nearest and most direct route from the intake to the up-cast, and serve no purpose whatever. The mine manager who complains of close and sultry weather outside as causing bad air in the mine workings, or who has bad air because there is no chance to drive a level out to day, simply says in other words that he does no understand how to ventilate, and ought not to be allowed to have charge of a mine.

It is now generally conceded by all intelligent practical men that for a shallow mine Guibal's ventilating fan is both a cheaper and a more powerful ventilator than a furnace, and even in deep mines this fan is fast superseding the furnace. It is the favorite ventilating power in Belgium and other mining States of Continental Europe. The mining law of Belgium prohibits the use of furnaces for ventilation in mines which discharge fire-damp, and within the past ten years the Guibal fan has been largely adopted in the fiery mining districts of Great Britian. The fan varies in size from ten to sixty feet in diameter. One hundred and ninety-one of Guibal's fans are now in use in the following districts in England, to wit: 62 in Northumberland, Durham, and Cumberland; 42 in Yorkshire aud Derbyshire; 24 in Wales and Monmouthshire; 28 in Staffordshire and Nottingham; 12 in the Cleveland district; 14 in the Wigan district; 9 in Scotland.

Some of these fans produce two hundred thousand to two hundred and forty thousand cubic feet of air per minute, and the least in power moves no less than twenty thousand to thirty thousand feet.

I copy the following statement from "The Engineer," an English journal of great abllity, in reference to the value of the fan as a ventilator:

> "There now appears to be a pretty universal preference for the fan as against the furnace for effecting the ventilation of mines. The old-fashioned cupola fire—which is at the present time in operation at hundreds of collieries in all parts of the country—has nowadays come to be looked upon with a great deal of suspicion. Many explosions have inferentially been traced to the fires thus used underground, and others have, to all appearance, been caused in the same manner. Mining engineers some time ago arrived at the conclusion that it would be better to discontinue the use of all underground fires, which are practically huge, naked lights, provided some equally effective mode of ventilation could be hit upon. With the hour came the man; the necessity brought forth the invention. Several fans for the need thus expressed were invented, and Guibal's particularly met with hearty approval. At all the new collieries which have been sunk in Durham, Yorkshire, Northumberland, and South Wales, the fan has been put down, and experiments have been most exhaustively made, the results of which have amply proved that the fan is equal to the furnace. Some experiments of this kind were made last week at the Oaks colliery of Messrs. Charles Cammell & Co. (limited), near Barnsley, where a new Guibal fan, forty feet in diameter by twelve feet in peripheral width, made by Messrs. Davy Brothers, of Sheffield, has just been erected. A number of mining engineers and colliery managers were present by invitation, and they were well satisfied that the fan is not only infinitely safer, but fully as efficacious as the old furnace. This particular fan, when the engines were running at twenty strokes per minute, withdrew 77,926 cubic feet of air in the same period; at thirty strokes, 107,856 cubic feet;

and at forty strokes, 140,694 cubic feet. In a tabulated form the results and conditions under which they were obtained are as follows:

Fan running per minute.	Thermometer.	Water-gauge. Inches.	Cubic feet per minute.
Strokes 20	71 deg.	5-10	77,926
Strokes 30	71 deg.	9-10	107,856
Strokes 40	71 deg.	13-10	140,674

The Oaks pits, as all mining engineers know, are very fiery, and exude a great deal of gas."

In shollow and non-fiery mines the advantages of the fan over the furnace, both in an economic point of view and for producing a greater flow of wind, are much greater than in deep and fiery pits, because the deeper the pit the greater is the ventilating power of the furnace, while the shallower the pit the greater the ventilating power of the fan.

In the anthracite regions of Pennsylvania Guibal's fan is coming into favor, and will before many years displace the furnace altogether. In the mining district of Schuylkill, in one hundred and seventy-one collieries there are one hundred and twelve fans in use, eighty-eight of which are in Schuylkill county, fifteen in Northumberland county, five in Columbia county, and four in Dauphin county. In our own State there is but one in operation, the furnace being the favorite power. The advantages of the fan consist in its cheapness and reliability. It can be placed over the up-cast compartment of the hoisting shaft, run by steam power from the boilers of the hoisting engine, requiring no attendance except such as can be bestowed by the hoisting engineer of the mine, and it is not liable to neglect like a furnace. In drift mines, however, where an air-shaft is always an up-cast, the fan will hardly be preferred to the furnace, though, as a ventilating power, its superiority must be acknowledged.

Mr. T. M. Williams, the most intelligent of the Pennsylvania mine inspectors, in his report for 1875, makes some valuable suggestions on mine ventilation and on the superiority of the fan over the furnace as a ventilating power in shallow mines. I copy the following from Mr. Williams's report:

"The matter of ventilation of mines is receiving much more attention in this district than it did years ago. Some of this activity is caused, no doubt, by the stern necessity of better ventilation from the increased discharge of explosive gas, etc., yet a large portion must be attributable to the law on mining and its connections. I would state, however, that there are many hundreds of our practical miners who do not understand any thing, comparatively speaking, about the laws of nature governing ventilation, and am sorry to state that a few of our bosses should be placed in the same category.

"When the writer made his first few official visits he recommended, among other changes necessary, the erection of fans of medium sizes at various places as a suitable means to cause the desired amount of ventilation. In some instances these suggestions were received kindly and acted upon promptly, and in each case gave entire satisfaction.

A few others insisted upon building furnaces, no doubt honestly thinking that such means would be the cheapest and would answer all purposes. I do not need to say much about the result in detail. Suffice it to be said that in nearly each case measures similar to what I had first recommended had to be resorted to, and that, too, after having spent large sums of money endeavoring to fight the plainest and simplest laws of nature.

"Many of the persons in charge of coal mines think that since so many of the works on mines and mining, published in England, Scotland, and Wales, give accounts of powerful ventilation where furnaces only were in use, and some of them deciding strongly in favor of the furnace as a means of securing proper ventilation, then surely it must follow that similar results should be had here, and all without reference to the conditions.

"The furnace as a ventilator is not well adapted to our shallow workings, and especially so on account of the great variations of temperature on the surface at different seasons of the year, and even at various periods of time during the same season.

"There are but few furnaces in use at present in the district. One in Mill drift and one in Boston colliery only remain of those in use prior to my official connection with the same. A double-arched furnace has since been built in a part of the Baltimore mines, and the aforementioned are about all that we have, and the loss would not be very seriously felt did we not even have them.

"A table accompanying this report will show that centrifugal fans are used mainly in this district, on the exhaust principle. These fans are of various patterns, and yet varying only in their details. The conditions under which our fans are placed are about as varied as are their construction. Some are erected immediately over an air-way at the head of the slope or shaft; others place them at a proper distance from the head of up-cast, so as to provide against concussion in case of an explosion of gas in the mine, etc. A few are located inside the mine."

RECOMMENDATIONS

The requirements of the law in regard to miners riding up slopes in front of loaded cars are, under the conditions existing at the majority of slopes, no safeguard against danger. There is generally no traveling-way for the miners to pass up and down, and the workmen assert that it is less dangerous to ride up in front of loaded cars than to walk up behind them. All slopes ought to have traveling-ways constructed between one side of the slope and the track, so that miners could pass up and down without coming in contact with the cars on the way. The provision, also, rendering miners liable to fine and imprisonment for working rooms or entries wider than the rule laid down by the mine boss, is unnecessary. The mine boss has absolute control of the mine, and can enforce his orders by docking or discharging the miners, as they are docked or discharged for not properly cleaning their coal when filling it in the mine cars.

Only one or two slopes have put in speaking-tubes. Where slopes are not so steep but that miners can walk up and down at will, tubes are not deemed necessary. In Pennsylvania they are only applied in slopes of such steepness that they can not be traveled through, of which there are none such in this State, nor are ever likely to be. The main object of such speaking-tubes is to provide the power of conversation between the outer world and the bottom of the mine, in case of accident cutting off the egress of the miners. They are a wise and necessary requirement in shafts of such depth that the human voice can not be distinctly heard and understood from the top to the bottom of the pit. If proper traveling-ways are provided in slopes, tubes may be dispensed with.

The majority, but not all shafts, have safety-catches applied on the cages. Some ropes have broken during the year, and the catch, though perfect when first put on, failed to hold the cage. These catches, like the ropes, require frequent examination and renewal, and I recommend that all such catches be required to be tested every six months, and the result sent to the Mine Inspector.

I have, in the body of the report, called attention to the necessity of legislation establishing a barrier-pillar between mines, to protect companies from the annoyance, danger, and expense incurred when holing through into the abandoned workings of adjoining mines. A pillar fifteen feet thick ought to be left standing between such mining properties, in justice to the firm working up towards excavated ground.

I desire to call attention to that provision of the law with respect to the ages and qualifications of boys before they are allowed to work in the mines. The statute says "no boy under twelve years of age shall be allowed to work in any mine, nor any minor, between the ages of twelve and sixteen years, unless he can read and write;" and it is made the duty of the agent of such mine to see that this part of the law is not violated, but there is no penalty attached for refusal or neglect to do so, and many agents of mines pay no attention whatever to the matter. Boys under ten and twelve years of age are at work in many mines. The fathers of such boys should be required to produce an affidavit as to their ages, before boys are allowed to go into the mine; the mine boss should be required to test the boys' ability to read and write, and fines and penalties should be provided for refusal or neglect to do so. Otherwise, this part of the law should be repealed, for, as it stands, it is of no binding force whatever.

There is a great and growing necessity for the establishment of a school of mines in the State, and until this is done provision ought to be forthwith made for the establishment of a mining department in the Agricultural and Mechanical College, wherein not only the sciences of geology and mineralogy would be taught, but also mine book-keeping, mine surveying, and mine drawing, or platting; also, a knowledge of the nature and properties of the noxious and poisonous gases of mines, and the laws which govern the motion of air. Many young men of the mines would gladly avail themselves of the opportunity of acquainting themselves with a knowledge of chemistry and physics, so as to enable them to understand those natural laws with which they are hourly called to deal. The objects of the mining law can not be fully realized until the officers in charge of the mines understand how to apply its precepts and enforce its provisions. And when we have more intelligent mining bosses we will have fewer strikes and troubles at the mines. The chronic discontent of miners, I know from practical experience as a working miner, arises from the foul and noxious air of mines, as surely as the toothache or hunger affects the spirit of man.

The mine maps were generally furnished, as the law required, when this provision of the act went into operation, but since then few additions have been forwarded. There is no necessity, in my judgment, in furnishing additions every four months, and even if there were the Mine Inspector has not the time to extend them. An addition every twelve months, or sooner, if required by the Inspector, would amply serve every purpose in view. But the maps left at the mines ought to be extended every four or six months, and they should be subject to the inspection of the State Superintendent of Mines, whenever required by him.

No inspector, single-handed, can visit and inspect all the mines in the State once in twelve months, even if such officer were doing nothing else all the year round but traveling from mine to mine, and, with his other duties to perform, he can not do so in two years. There ought to be an assistant furnished this office, or at least a clerk, if the work contemplated by the law is to be performed. All the mines in the State should be visited and inspected once each year, and oftener, if required, as many of them do require to be.

During the strike in the Tuscarawas Valley region, last spring, the wooden structures covering and surrounding the shaft of the Silver Creek Mining Company, in Wayne county, were destroyed by fire. The fire was the result of carelessness or accident, and occurred while the State militia were guarding this mining property. There were no people under ground at the time, though had there been, escape was assured through the escapement-shaft of the mine, there being three separate outlets. Adjutant-General Wikoff, who was in the Massillon district when this fire occurred, suggested to me the advantage of having the mining law so amended as to require all operators of shaft mines to provide water-hose for extinguishing fires, and I recommend that this be done. Fires occur at some shaft or another every year or two. Where there is a blazing furnace at the bottom of the up-cast there would be imminent danger of loss of life, even with two separate shafts to a mine, should a fire occur at the hoisting shaft while the miners were at work below. Even if there was no danger of loss of life, there would be a saving of property by having means constantly on hand to extinguish fires. When the Wayne county shaft burned down there was not as much as a bucket around the mine. Messrs. Wick & Wells, the owners of the Austintown Shaft, in Mahoning county, keep water-hose at their mine, for the purpose of extinguishing fire, but I know of no other mine-owners who do.

ANCIENT MINERS.

Underground mining, whether of coal or other minerals, has ever been regarded as labor fraught with peculiar dangers and hardships. Most people, unaccustomed to its scenes from boyhood, experience some degree of horror at the thought of being buried, even for a few hours, in the bowels of the earth. Among the ancients, so great was the horror of mining, that all underground work was assigned to slaves and convicts. In Egypt, and other ancient kingdoms, the mines were the property of the kings and the miners were convicts, prisoners of war, and purchased slaves. Both sexes, and children of all ages, were compelled to labor in the mines, and they lived there day and night. The miners, divided into different gangs, were placed under overseers of different nationalities, and were chained to prevent them from mutiny and escape. Their labors were terribly exhausting. At thirty years of age the strongest men were worn down, from the effects of mephitic gases, cruel treatment, and hard work, and many of them were forced to labor until they fell dead.

As late as the year 1775 the coal miners of Scotland were bound for life to work in the mines, and were transferable with the mine property. In 1606 one of the acts of the Scottish Parliament, passed that year, declared that all colliers who should leave their masters, without their consent, were to be esteemed and held as thieves, and full permission was given in the same act to all masters and owners of coal mines to lay hold of all vagabonds and sturdy beggars and compel them to work in the mines, to which occupation they were ever afterward bound.

In these modern days of civilization and enlightened education, however, the occupation of a miner is regarded with honor; all known and approved safeguards are thrown round him, which the arts and sciences can commend, to make his occupation safe and salubrious; and the adventurous men who, amidst subterranean darkness, noxious vapors, and the crushing of falling strata, venture into the caverns of the earth to wrest its mineral treasures from their native beds for the use and comfort of their fellow-men, are proud of their occupation.*

THE MINERS OF OHIO.

Miners, from whatever nationality they may have originally come, or whether natives for generations have many ideas in common. Working by the piece, or ton, each is, in a sense, his own boss. When work is plenty and cars are abundant, they work with uncommon energy, one man often doing in eight or nine hours what would be a fair day's work for two men. No man will admit that another can put more coal than he, and the younger and more robust will seldom acknowledge that they are ever tired. During the slack or dull seasons of the year they have a great deal of leisure time waiting on cars in the mine, and they pass most of this spare time in groups, the main topic of discussion at these social gatherings being the relation of labor and capital. Any man who takes a contract for work at less than the usual price is regarded as having disgraced himself. During a strike it is held to be an infamous act to work (blackleg), and men regard it as a high honor to be able to say that neither themselves or any of their relations ever did so.

There are many grades of intelligence among these underground coal workers, but, taking the whole body together, they may be divided into two distinct classes—the temperate and industrious, and the intemperate and thriftless. There are about as many of the one class as the other. The larger number of the temperate and industrious are professing Christians, members of the church, are readers of books and newspapers, and will take rank as among the most intelligent of the workingmen of the State. The church members are generally Baptists, Methodists, and Presbyterians.

They are keen disputants of those church doctrines which have divided Protestants for two hundred years, and often, in the murky chambers of the coal mine, during the leisure hours of a working-day, scenes of real life may be witnessed, such as Milton, in "Paradise Lost," has portrayed as occurring in the realms of Heaven before man was formed of the dust of the earth.

> "Others apart sat on a hill retired,
> In thoughts more elevate, and reasoned high
> Of Providence, fore-knowledge, will and fate,
> Fixed fate, free will, fore-knowledge absolute."

Many of this class of men own the houses and lots in which they live, and have money out at interest. Some of them, who have large families of children, have little ahead, but they pay their way as they go, and owe no man a cent.

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*In Germany the special safeguard of law for the protection of miners, and for the care of the aged, the crippled, and the diseased, has made the miners the proudest class of the people. "He is as proud as a miner," is a common saying.

The intemperate and thriftless class pass most of their spare time in the saloons of the mining villages. These places are the curse of the coal mines, and they are as numerous as they are demoralizing. They are frequently kept by miners who have been victimized for having been conspicuous in some former strike, and who profess to be heroes and martyrs to the cause of labor. Sometimes a miner who has been crippled by a fall of rock or coal, or whose lungs have been wasted by working amidst the foul and noxious gases of a badly ventilated mine, engages in the business as his only means of making a living.

Men who pass their working time in a coal mine and their idle time in a saloon can not have broad and liberal views of the true relations of labor and capital. The only way too many of such men think of redressing any grievance, real or imaginary, is by force. When a mining district is confronted with a proposition coming from the operators, to reduce the rate of wages, or when the miners themselves deem an advance due, this class of men are always ready to strike, yet a majority of them are probably not in a condition to stand out on their own resources for twenty-four hours.

Some of the noblest deeds ever performed by man—deeds which, had they occurred on the battle-field, would have been rewarded with high public honors and emoluments—have been performed by miners on the occasion of mining catastrophes. On the occurrence of every accident, however dangerous, there are a dozen or one hundred men ready to plunge into danger, or death itself, in the hope of rescuing a fellow-workman. This race of men are also as remarkable for their generosity as for their spirit of daring. When any one of their number gets hurt in the mine in the pursuit of his calling, his associates are always ready to assist his family until their fellow-craftsman's wounds are healed, and he is again fit for work.

The character which I have drawn of miners seldom finds its way into the public press, and what the public usually know of this race of men has been learned of them during the prevalence of a strike, when their blood is hot and their evil passions are aroused. Even then the vices and follies of miners are exaggerated one hundred fold. As M. Simonin well says in "Underground Life," "the public has passed by the collier with too much indifference; the philosopher, the savant, the artist, th romance writer have not sufficiently examined him."

The following statement in reference to the character of British miners, a race of men from which the great majority of our American miners are drawn, is taken from "Colliery Management," an able work by Jonathan Hyslop, Esq., a colliery proprietor and mining engineer in Lanark, Scotland.

> "It is now nearly twenty-five years since my apprenticeship commenced at an English colliery, and thus the greater portion of my life has been spent in daily contact with miners.
>
> "During that time I have had ample opportunity of knowing them; have stood in various relationships to them; have dealt with English, Scotch, and Irish in all the varying phases of trade, and the result is, so far as that experience goes, I have found them reasonable when fairly dealt with, grateful in return for kindness, ready to put forth extra effort in emergencies, forbearing when they might have done harm, slow to take advantage of mistakes, and as faithful and obliging as the workmen of any other class."

BAD AIR IN COAL MINES, AND ITS EFFECT ON THE HEALTH AND HABITS OF MINERS.*

During the past ten years the numerous protracted and bitter strikes which have occurred among coal miners, growing out of wages disputes with their employers, have attracted a great deal of public attention. Not a few of these strikes have been attended with intimidation and lawlessness, especially when the mine-owners have attempted to introduce new laborers to supplant those on strike. Several bills have been introduced in various State Legislatures bearing more or less upon the subject of strikes, the more direct purport of which have been to provide pains and penalties for interference by threats, intimidations, or innuendoes of violence on the part of strikers with laborers who were willing to work during the prevalence of a strike. The opponents of such legislation have held that the laws now upon the statute books are amply sufficient to protect the rights of all parties in interest, and that no additional legislation would be of any avail, either in preventing strikes or in preventing outbreaks against law and order, and so far no new legislation has been had upon the subject.

Miners strike oftener than other laborers, and their strikes are also more protracted, and are accompanied with more bitterness of feeling and lawlessness; and hence has arisen the demand so frequently made of late years for conspiracy laws and legislation to prevent intimidation, violence, and other lawless acts during the prevalence of strikes at the mines.

In refusing to pass any laws on the subject, I think the law-making power has acted wisely, because such laws, sought mainly by mine-owners, would only increase the discontent of the miners, and cause them to feel that they were degraded at the behests of their employers. In this country, where the government and all social progress is founded on the will and happiness of all the people, true statesmanship consists in discovering the sources of discontent, and then of removing them by necessary legislation. The very existence of the Republic is associated with the freedom and happiness of the great army of laboring men.

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*A paper read before the Washingtonville (Ohio) Miners' Institute, August 15, 1876.

The sources of discontent among miners arise not, in my judgment, so much in the evil nature of the men, as in the evil genius of the mines, and not conspiracy laws are needed to compel miners to be law-abiding citizens, but better ventilation is needed to expel the demons of the mines—those noxious gases which in remoter ages the priests of Germany were wont to combat with religious exorcisms.

The noxious and poisonous gases of coal mines are fire-damp (light carbureted hydrogen gas), black-damp (carbonic acid gas), white-damp (carbonic oxide gas), and sulphureted hydrogen gas, also called white-damp by the miners. The more fatal and dangerous of these gases—mainly for the reason that they are given off or produced in greater quantities than the others—are the fire-damp and the black-damp. The former is the explosive gas, that dread scourge of many English coal mines. It is found in greatest abundance in mines varying from six hundred to twelve hundred feet in perpendicular depth. Shallow mines seldom produce it in alarming quantities, and most of such mines are entirely free from its presence. Black-damp is found in every mine, being produced from causes which are in constant operation—by human respiration, the excrementitious deposits of men and animals, decaying timber, the decomposition of small coal and shale, the combustion of gunpowder, and the workmen's lamps; and it is constantly exuding from the coal strata.

This gas is heavier than atmospheric air, in the relation of three to two, and when found in a pure state it occupies the floor of the mines in a solid stratum. It, however, readily diffuses through the air, obeying a well-known law of the diffusion of gases, and in this diffused state it is generally found in the working places of coal mines. When three per cent. of it is mixed with the air of mines, the miners' lamps burn with a dull, heavy flame, and go out unless moved with caution. They are, therefore, hung on posts or on the pillars' sides. This is the condition of many working places in mines in which no fire-damp is made.

The air is best in the morning, because the circulation is partially, if not wholly, renewed in the night during the absence of the miners; but in the afternoon and toward quitting time it becomes very foul, and miners frequently leave work because their lights will no longer burn, or because they are so oppressed with languor and headache that they can no longer stay in the mine.

The black-damp, however, is more insidious than direct in its operations, gradually undermining the constitution and killing the men by inches. By reason of constant habit, young and robust miners are able to stay several hours in a mine after a light goes out for want of fresh air, where a stranger, unused to such scenes, would fall insensible, and if not speedily removed would die.

Mines are frequently in a very defective state at the wall faces where the people are at work, while a good current of air is flowing along the main galleries of the mine. Indeed, there may be many times the quantity of air required to ventilate a mine well entering by the in-take and returning by the up-cast compartment, and there be bad air prevailing at the working faces. One part of a mine may also be well ventilated while another part, particularly the inmost workings, has bad air. These results are caused by the air-courses being too far behind, or by the air breaking through faulty stoppings and badly hung doors, and returning to the up-cast.

We have little fire-damp in the coal mines of the United States, and to this circumstance, fortunate in one sense but unfortunate in another, is due the prevailing bad air of the mines. Where fire-damp abounds a strong and vigorous ventilation must ever be maintained—the moving current of air sweeping the faces of the workings where the people are employed. If the state of the mine atmosphere is neglected for a single hour, explosion follows, carrying death and desolation in its track. To guard against explosion, powerful and costly furnaces or fans are erected, air-courses are driven, stoppings built, brattice is applied, and a never-ceasing vigilance exercised through all the many ramifications of the mine, and the gas itself, by reason of its levity, assists in providing a sweeping current of air. Where, however, no fire-damp is given off from the strata, the furnace or fan is too often neglected to the last hour—that is, till the workmen's lamps will no longer burn—and when provided is too small to give motion to the necessary quantity of air. Air-courses are also neglected, or when driven are kept too far behind the workings, and stoppings are not promptly erected; as a consequence, miners are plunged in an ever-thickening atmosphere. If gunpowder is freely used in breaking out the coal from the wall faces, blinding and suffocating volumes of smoke in addition load the air of mines the whole working-day.

A general but a very erroneous opinion prevails, not only on the part of the public, but even among mine-owners, that mines in which no fire-damp is given off are not dangerous to life, as compared with explosive mines. This would be true if non-explosive mines were as well ventilated as those which make fire-damp. But adequate ventilation is not applied in such mines, because they can be wrought without going to the expense of providing costly and elaborate furnaces or fans, air-courses, stoppings, and brattice. From four to six cents a ton are thus saved in mining the coal that should be applied in ventilating, but saved at the expense of the workmen's health, and are lost one hundred fold in the strikes and the resulting destruction of mining property. When the ventilation is neglected in fiery mines, explosion follows, as already stated, and all the world knows the result; but when the ventilation is neglected in non-fiery mines, and men are dying by inches, the world knows it not. The complaints of the miners—and they are ever grumbling and fault-finding when working in bad air—are too often set down as whims worthy of no regard.

It appears from the reports and testimony of experts that the non-explosive mines of Great Britian were formerly in the same condition as to defective ventilation as were and are those of too many in America. Before the passage of the first British coal mines inspection act, J. K. Blackwell, Esq., a practical miner of great ability and scientific attainments, was appointed a Commissioner of Mines by the Secretary of State in 1849, with instructions to make an inspection of the sanitary condition of mines. Mr. Blackwell, in his report, referring to mines in which little or no fire-damp is made, says:

"There is another class of injuries, resulting from defective ventilation, to which miners are exposed. The circumstances producing these injuries are slow in operation, and as their effects bring disease, and not immediate and sudden death, their existence has been little considered. A careful examination of the state of mines leads to the conclusion that the ultimate loss of life is greater from this cause than even from explosions.

"These effects are the result of an inadequate supply of air, which has become vitiated and unfit for breathing, on account of its having lost its due proportion of oxygen, which is replaced by the formation of carbonic acid. This gas has its sources from respiration, the lights of the mine, the decomposition of small coal in the goaves, and of timber in the workings. Air in this state is also usually found to be loaded with carbureted hydrogen, yielded from the whole coal, or in the goaves. Sulphureted hydrogen, arising from the decomposition of pyrites, is sometimes present, especially in coal seams liable to spontaneous ignition. The gases formed by blasting are also allowed to load the air of mines to a very injurious degree.

"This state of the atmosphere of mines arises from the want of the necessary air-ways and other arrangements to discharge such portions of the air in circulation as may have acquired this condition, and to afford a fresh and pure supply at any part of the workings.

"Those districts and seams of coal least affected by inflammable gas are generally those in which the ventilation is allowed to be in this imperfect and injurious state, on account of attention not having been called so imperiously to the subject as it is by the violent catastrophes resulting from explosions."

And in 1864 Thomas E. Foster, Government Inspector of Mines, made the following statement before a committee of the House of Lords in reference to this class of mines:

> "In the collieries that I alluded to as being badly ventilated, they had no inflammable gas, and that was the reason they were not well ventilated. Although you sometimes kill a few men by an explosion, these collieries where they have no inflammable gas kill the men by inches. There are quite as many, in my opinion, killed where there is nothing but carbonic acid gas as where there is inflammable gas. The men's health is naturally destroyed, and they kill them by inches. They do not go immediately, but they go on for a few years and die."

The following cases, reported by Dr. William Thomson, show the condition of the lungs of the miners after death:

D. C., age fifty-eight years; miner twelve years; lungs uniformly black, and of a carbonaceous color.

D. D., age sixty-two years; miner from boyhood; lungs uniformly black; not a vestige of natural color left.

G. H., age forty-five years; lungs uniformly deep black through their whole substance, with a density equal to caoutchouc.

L. A., age fifty-four years; miner all his life; whole lungs dyed with black carbonaceous matter.

Dr. Daniel C. Rathburn, of Middleport, Ohio, gave the following testimony before the Ohio Mining Commission in reference to the occupation of miners:

> "Miners are subject to rheumatism and lumbago, in consequence of their special occupation. I attribute it to their working much in a stooping position in a damp situation, and also lifting large lumps of coal in the same attitude. These are chronic diseases among them. There are a good many cases of asthma, which I think arise from the peculiar atmosphere charged with carbonaceous particles.
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> "I have made two post-mortem examinations in which there was carbonaceous solidification in the air cells. The Scotch people call it spurious melanosis, really a coal miner's consumption. I have no doubt the carbonaceous particles caused their death. I examined them after death, because before their decease they spit up a black substance whose real character I wished to ascertain. Four cases came to my knowledge. The books speak of such cases."

The States of Pennsylvania, Maryland, Ohio, and Illinois, the four important mining States of the Union, recognizing the many and peculiar perils of the mine, have of late years enacted laws for the regulation and ventilation of mines, and provided State superintendents of mines to see that the laws were enforced and obeyed. Although these laws contain many useful and necessary provisions for the protection of the health and safety of miners, in addition to the requirements of good ventilation, the miners have, as with one accord, named them the "Ventilation Acts," caring little for other needed protection in comparison with the necessity of improved ventilation.

Though these laws have been in operation for six years in Pennsylvania, three years in Illinois, and two years in Ohio, the work of improvement in mine ventilation has been very slow. The mine-owners conceded the necessity of such legislation very grudgingly, looking upon it as an unnecessary and unwarranted interference with the business of coal mining, and have sought to evade the law, rather than obey its requirements and apply its precepts.

Unfortunately, too, the majority of the persons selected as the mine inspectors, albeit life-long practical miners, were men of little or no education beyond the mere ability to read and write, and their published reports are of little value to mining beyond the statistical matter they contain. This is the misfortune, not the fault, of these officers, for most of them were literally carried from the cradle to the coal mine, and never saw the inside of a school-room six months in their lives. Though unacquainted with those natural laws with which they are hourly called to deal, they are honest and earnest in their endeavors to see improved ventilation and other safeguards of mining applied for increased security to the lives and health of miners. A practical miner, without any education whatever, is of more value as a State superintendent of mines than an educated mine inspector without practical knowledge and experience. No more ludicrious spectacle is ever seen in the bowels of the earth than that of a person unaccustomed to the depth, and gloom, and danger of a coal mine, groping his way along the many intricate galleries and chambers, aided by the feeble light of a miner's lamp.

With the development of our coal mines comes the necessity for official supervision in the interest of the underground workman. The enactment of mining laws, in turn, calls for the establishment of mining schools for the purpose of imparting practical scientific education. We have an Agricultural and Mechanical College in the State of Ohio, erected and maintained at great expense, for teaching practical science in the agricultural and mechanic arts, and the necessity for a mining college is equally urgent. When we have State mining schools, and educated master miners and State superintendents of mines, we will soon have a mining literature that will command attention and respect.

Underground operations are far removed from public knowledge and investigation, and when the peculiar perils and privations of the mine are recorded in official reports, in language that will command the ear of the American public, miners will be commisserated where they are now cursed, and will be honored where they are now despised. Many of their failings, their fierce and intolerant spirit, their hatred of their employers and of vested capital, their spirit of fault-finding, and their love of striking, are, beyond any question of doubt, caused by deprivation of solar light, and (more particularly) the ill-ventilated condition of the mines—causes not understood by the public, because the public have never investigated them.

The general public has no patience, and seldom any sympathy, with miners in their numerous strikes and wages disputes with their employers, and regard as consummate folly the policy which seeks redress for grievances, real or imaginary, through strikes.

The mine-owners blame the leaders and agitators at the mines for causing all the trouble at the mines, and the public has accepted this view as the facts in the case. But men would not continue to strike year after year, in the face of repeated loss and disaster, denying themselves and their children the comforts and necessities of life, and consuming the fruits of previous earnings, for no other reason than because leaders and agitators tell them to do so. All men profit by experience, and even children cease playing with edged tools when they find they cut both ways. The peculiar surroundings of the mines are at the foundation of many a long and disastrous strike. A plant deprived of the light of day, though carefully nourished with all the other elements of growth and life, is never as vigorous as one which basks in God's sunlight. So it is with man; deprivation of solar light, the awful gloom of the mine, and, in especial, the noxious air which lurks there, have their influence on both the body and mind of the miner.

Constant labor in a badly aired mine breaks down the constitution and clouds the intellect. The lungs become clogged up from inhaling coal dust, and from breathing noxious air; the body and limbs become stiff and sore, and the mind loses the power of vigorous thought. After six years' labor in a badly ventilated mine—that is, a mine where a man with a good constitution may from habit be able to work every day for several years—the lungs begin to change to a bluish color. After twelve years they are black, and after twenty years they are densely black, not a vestige of natural color remaining, and are little better than carbon itself. The miner dies at thirty-five years of coal-miner's consumption. In a mine where the circulation is constantly renewed, and a pure current made to sweep the faces of the workings where the people are employed, little or no injury to health results from underground coal mining, but the blighting influence of want of solar light remains. Six to eight hours immersion in a coal mine in a working-day is as long as nature can stand, as mines are generally operated, without injury at an early age to the constitution and vigor of the mind.

When business men, literary men, and, in short, men of every profession, who have means, overtax their minds and undermine their health by too close application to study and duty, they seek rest and recuperation by a few weeks' or months' travel in the country, or they take a trip to Europe, etc., and in this course they are encouraged and advised by their physicians. Human nature is the same in the miner's cottage as in the mansion of the rich and great; and hence when the miner becomes worked down in exhausting subterranean regions to which there is no parallel on earth, and nature demands rest and recuperation, he finds it in a strike. The lives of miners are prolonged many years by reason of their numerous strikes. The better policy would be for the miner, when he finds his health and physical energies giving way, to change his occupation, or seek recuperation by resting singly; but men whose intellects have become clouded, whose tempers have become soured, and whose bones have become stiff and sore by breathing the foul and noxious air of the mine, can not reason. The best remedy for the prevention of strikes and consequent lawlessness is not in cursing the folly and fatuity of miners, nor in urging the enactment of conspiracy laws, but in applying thorough and vigorous and never-ceasing ventilation in the mines.

Jules Verne, one of the ablest writers of our times, has drawn a picture of a peaceful village whose inhabitants had lived for centuries in harmony and contentment. By a peculiar process, Dr. Ox extracted from the air its due proportion of oxygen. The simple villagers, who had lived for centuries in peace, became fretful and quarrelsome. Fanciful wrongs, which formerly were passed by without concern, assumed large proportions; neighbors who had been life-long friends became bitter enemies. The quarrel did not confine itself to the village, but all the surrounding villages were regarded as enemies. War ensued, and there was no end to the quarrel until the Doctor was discovered at his nefarious work and got rid of.

This picture, applied to the mining villages of the United States, is true to life, and before miners can become as reasonable and contented as the workingmen in other departments of life, the nefarious practice of bad ventilation in mines must be got rid of. To have systematic perfection in ventilation we must have more intelligent and public-spirited underground managers and mine-owners. Instead of seeking to evade the law, and to hide their criminal carelessness or incompetency by asserting that mines in which no fire-damp abounds do not require much attention as to ventilation, and are not dangerous to health and life, they must show a willingness and an ability to provide elaborate and timely appliances to give motion to strong and vigorous currents of air, and to discharge the air in circulation at the working faces of the miners, so that the poisonous gases will be swept away as fast as they are given off. And this is true economy; but aside from pecuniary considerations, the well-being of society demands it.

I am aware that there are other causes tending to produce strikes among miners, but the same causes exist in every other trade. Strikes occur in other trades as well as among miners, but they occur ten times more frequently and are tenfold more protracted among miners than in other occupations. With shorter working hours—eight hours amidst the awful gloom of the mine, even with good air, being equivalent to ten hours above ground—with systematic perfection in ventilation, and the adoption of boards of conciliation and arbitration for the adjustment of all disputes as they arise, strikes would soon disappear at the mines forever.

Unless the mine atmosphere becomes too foul to admit working every day, miners seldom lay down their tools in strike and demand better ventilation. The air of a mine, as I have said, is always better in some places than others, and miners working in the worst air will work as long as they can stand up for fear of being regarded by their fellows as lacking unusual power of endurance. All miners pride themselves on their physical power and their dauntless spirit in braving either the fiery or mephitic dangers of the mine. The pernicious influence of breathing bad air on the habits of the miners, making them quarrelsome and fault-finding, is, however, none the less certain and sure.

STRIKES AND ARBITRATION.

Workingmen have the right, either individually or in mass, to demand higher wages, to refuse to work if the demand is not complied with, to refuse to accept a proposed reduction in wages, have the right to call public meetings of their fellows and discuss questions of an advance or a reduction of wages, or any other questions affecting their interests, and to strike in a body if they deem such action proper; but if one or more refuse to be bound by the action of the meeting which resolves to strike, the right of the minority to so refuse and work against the will of the majority is as sacred as the right of the majority to resolve to strike. On the other hand, employers have the right to employ new men on any condition they choose, to take the place of workingmen on a strike, and this right is as sacred as the right of workingmen to meet and vote to suspend work when they become dissatisfied with existing rates of wages. The legislature can not interfere with these rights without giving one party in interest an advantage over the other. The only proper thing the law-making power can do is to keep its hands off and allow the parties in interest to settle their disputes as they see fit.

Were all strikes to resolve themselves into questions of endurance between the two parties, acts of lawlessness would seldom be committed on the part of the strikers. But the operators, when they find the miners more resolute and enduring than they had calculated upon, use other means than starvation to break up the combination. They endeavor to induce the more moderate and sensible among the strikers to resume work; but such men, although opposed to striking, will not work unless the majority agree to do so, nor would it be safe for them to do so if they were willing.

Advertisements are sometimes made in remote mining districts by the operators, setting forth the inducement of steady work and good wages. They are met by counter advertisements from the strikers, urging all fellow-craftsmen to stay away from the district until the dispute is settled; and so perfectly are the miners organized by common ideas of honor that no inducement in the shape of increased wages will prevail with any of the regular craft to take the places of their fellows on a strike. When new miners are secured they are usually immigrants, ignorant of our language, or negro ex-slaves. The presence of these strangers at the mines arouses the angry passions of the strikers, and rioting and incendiarism are to be feared.

This condition of affairs is, however, not applicable to coal miners alone. Whenever new men are brought to take the places of men on a strike, it seems to make little difference whether the strikers be ignorant men or intelligent men, whether railroad laborers, coal miners, or skilled mechanics, trouble will follow unless the strangers are protected; and this is true not of workingmen of the United States alone, but of every country where laborers have the right of combination. The strikers look upon the strangers as hirelings brought to degrade labor, as men taking the bite out of their children's mouths, and denounce them as "blacklegs," or "skabs," or "rats," according to the approbrious epithet in use in trade organizations. More rioting occurs by miners, during attempts made to supplant their labor by foreign labor, than among other laborers, because miners' strikes are more frequent and protracted than those by other laborers, and because of the unreasoning disposition of miners, resulting, as already stated, from breathing the foul and noxious airs of the mine.

Until the year 1824 workingmen were forbidden by law in Great Britain from forming combinations to strike. In that year the coalition act of 1800 was repealed, and since that time a perpetual warfare of strikes has been waged between capital and labor. Not a single year ever passed, before the principle of arbitration and conciliation was adopted for settling wages disputes, that did not witness some great conflict in which thousands of laborers were engaged on a strike over the adjustment of wages, and the majority of these strikes have been attended by lawlessness when new men were brought to supplant the strikers, and this, too, in a country so densely populated, so full of soldiers and police as England. During the miners' strike in the Staffordshire collieries in 1864, when many of the strikers, having become convinced of the folly of further resistance, resumed work, they were met in the morning by the bolder spirits who still held out, and denounced as blacklegs. In some cases rough hand grenades were thrown into the houses of those who had resumed work at the reduction, and two troops of lanciers, headed by the lord lieutenant of the county, had to be called out to aid the local police in preserving the peace.

Many a long and disastrous conflict might have been avoided if representative men of both parties had met and discussed the situation before the strike was inaugurated. This plan is seldom followed. Meetings frequently occur during the prevalence of a strike for the purpose of arriving at an amicable adjustment of difficulties, but all such meetings fail of any good results, ending in wrangling and bickerings. The blood is now up, and it is a question of victory with both. A better plan than meeting in advance, and one which has been attended with the most gratifying success in Great Britain, among the various industries, is the establishment of boards of conciliation and arbitration. A late trades union conference in London, representing 700,000 workingmen, solemnly resolved that in the future recourse would in no case be had to a strike, but all wages or other trade disputes should, as they arise, be referred to a joint delegation of employers and employed, presided over by an umpire.

The manner in which these boards of conciliation and arbitration originated in Great Britain, and the happy results which have followed from their inauguration, were well described by Mr. Mundella, one of their founders, himself originally a workingman, though now one of the largest employers of labor in England, in his speech delivered in New York a few years ago. Since Mr. Mundella's speech was delivered, the principle and practice of arbitration for the adjustment of wages disputes have grown in public favor in Great Britain, and Parliament has passed a law for the encouragement of the principle. I copy the following extract from Mr. Mundella's speech:

"Ten years ago, in the town in which I reside, and in the trade with which I am connected, we had the third strike in one year. This last one had continued for eleven weeks. A few of us were heartily sick of this state of things, and we resolved to try if some means could not be devised, not only to put an end to the strike, but to prevent its recurrence in the future. We had a fearful history of conflict to increase our difficulties. We had old hatreds, old fueds, dating from the beginning of the century. The neighborhood was one proverbial for its quarrels between capital and labor. When machinery was introduced to aid labor, labor rebelled. Frame-breaking was the order of the day, and arose to such a disastrous height that Parliament passed a law making the destruction punishable with death The death p nalty was inflicted on six men at one time for frame-breaking, in my town. Strikes had continued all along until 1859. We called the workingmen together, or their representatives rather, and we said to them, 'You are all wasting your funds in fighting against us; when you should be making money you are squandering it, and when the time comes that your labor is not in demand your employers will take that opportunity to oppress you.' We agreed to form a board of arbitration and conciliation, and we discussed the question for three days, with a great deal of mutual hostility, and a great deal of strangeness of feeling to find ourselves in the same room with the leaders of the trades unions. However, some of us were resolute and carried it. We constituted a council, to consist equally of employers and employed. The trades unions were to elect seven members by universal suffrage in their bodies, and the manufacturers their seven in the same way. These gentlemen were to meet in some public room—the room of the chamber of commerce, indeed, it was—and around a common table, and meet not only when there were disputes, but to prevent disputes, periodically, not less than once a quarter, and discuss questions of labor, all in fact affecting the relations of employer and employed. We then employed a committee of inquiry, two of each of our respective parties, who should hear privately any quarrel in the initiative state, and if possible crush the thing out there. Well, you may judge under what feelings we entered the room the first time, seven employers and seven men regarded as their bitterest enemies. However, courtesy and kindness begat a reciprocal feeling, and we commenced by electing a president. I was elected the first president, and we elected a workingman vice-president in order that we might not be outdone in courtesy by the workingmen. I have sat for ten years at the head of that table, and that same workingman as vice-president has sat at the other end. We elected a secretary from each party, and we have kept a record of our proceedings from that day to this. We have had some very tough arguments and difficult times to pass through, a great deal of what workingmen in England call 'jaw.' However, it is a great deal better than those long struggles and bitter animosities that used to exist between us. We have never lost one day's labor from that day to this. The change that has come over the spirit of the neighborhood is remarked throughout England; and, thank God, the hatchet is so buried that if dug up to-morrow it would be too rusty and rotten to be used. Well, we continued patiently on our way with our experiment. Some of the employers of the other towns would not have any thing to do with it. 'What,' they said, 'sit down with the trades union leaders! Never, never.' However, we told them that the trades union leaders had enlightened us on some questions, and on some we had enlightened them. Gradually they fell in until all the unions and all the employers are in, and we are all homogeneous. If we are in a particularly tight place—a difficulty which we can not settle—both parties agree upon an impartial umpire, whose decision is final. This has only occurred once with us, when a reduction of wages was deemed absolutely necessary and just by the manufacturers, and the unions would only agree to half the reduction. An umpire was called in, and he split the difference between us. What happened? One section of one union said: 'We will not stand it; we will strike.' They tried to get the other men to strike. 'What,' they said 'call in an umpire and not abide his decision!' and the result was the workmen kept faith, and every man went back to his work. Finding our system worked so well, other trades followed our example. The first was the lace trade, and they have had no strike since. Then the Staffordshire potteries, and they report enthusiastically of it. Last of all, after eleven months of a terrible strike among the iron-workers, which reduced the people until they were without beds or furniture, sleeping on straw, their children bare-foot, the women having sold the children's shoes to get bread to maintain the strike, all on the verge of starvation, through the warm, earnest advocacy of a good Quaker friend they adopted the same thing. What happened? They have worked without a day's cessation from then to this time. Once since they had occasion to call in Judge Eckel as an umpire, and after he got to them, concluded they could settle their dispute amicably among themselves, and did so without his intervention. Again, my friend Mr. Hughes was called upon to act as umpire in a question of vital interest to the whole Cleveland district. The second day of the argument before him both parties were reasonable. In half an hour then all was settled; they had agreed upon the rates of wages for the succeeding year. In the building trades—the carpenters and builders—of which Mr. Garth is the head, there are more than twenty boards of arbitration at work in the different towns of England. In some there is a composite board of plumbers, stone-masons, carpenters, etc., who sit down together once a quarter or once a month, and by talking things over like men and Christains, with a kindly feeling toward each other, they arrive at a proper solution of all their difficulties. And now, gentlemen, I have explained to you what this is, and it is very simple, and something which can be introduced every where. What can be done in old England can be done in New England, and what can be done in either can be done in the iron and coal districts of Pennsylvania, or any where else."

The national union of operative boot and shoe riveters and finishers, of Stafford, England, have, in conjunction with their employers, recently adopted the system of arbitration in the settlement of trade disputes. The list of officers is as follows: President, an employer; Vice-President, a workman; Board, six employers and six workmen; Reserve members, to be summoned in absence of others, two employers and two workmen; Referee, an outsider; treasurer, an employer; Committee of Inquiry, two employers and two workmen; Secretary, a workman.

The following are the rules of the Board:

1. That a Board of Trade be formed, to be styled "The Board of Arbitration for the Boot and Shoe Trade of Stafford."

2. That the object of the said Board shall be to arbitrate on any questions that may be referred to it from time to time, by the employers or workmen, and by conciliatory means to interpose its influence to put an end to any disputes that may arise.

3. That the Board be constituted as follows: Six manufacturers and six workmen, and a reserve of two on each side. Three manufacturers and three workmen to form a quorum. The manufacturers to be elected by a meeting of their own body. The whole of the Board to serve for one year, and be eligible for reëlection. The new Board to be elected in the month of January each year.

4. That the Board shall meet for the transaction of business quarterly, viz., in the first week of the months of January, April, July, and October, the secretary to furnish the members of the Board, seven days prior to the meeting, with the detail of the business to be transacted.

5. That all complaints submitted to the Board for their investigation be embodied in writing, stating, as clearly as possible, the nature of the grievances complained of, such statements to be sent to the secretary at least fourteen days prior to the Board meeting; and that in case of votes being equal, appeal shall be made to the referee, whose decision shall be final and binding.

6. That no member speak more than once on any one subject, and that his speech be limited to five minutes.

7. If at any meeting of the Board the number of employers and workmen is unequal, all shall have the right of fully entering into the discussion of any matters brought before them, but only an equal number of each shall vote. The withdrawal of the members of whichever body may be in excess shall be by ballot.

8. That any expenses incurred by the Board be borne equally by the employers and workmen.

9. It is agreed that in case of any dispute work shall be continued, and paid for as previously, until the decision of the Board is arrived at; but should any new class of work be introduced upon which a dispute shall arise, it shall be referred to the committee of Inquiry, whose decision shall be binding until the next quarterly meeting.

10. That no alteration or addition be made to these rules except at a quarterly meeting, or at a special meeting convened for that purpose. Notice of any proposed alteration shall be given, in writing, one month previous to such meeting.

The following additional testimony on the value of arbitration and conciliation boards is taken from the recent work of Dr. Edward Young, Chief of the United States Bureau of Statistics, entitled "Labor in Europe and America":

Trades-unionism in England is an established fact, and a power which, although many politicians try to shirk or avoid, it is best to openly admit. The unprejudiced observer must allow that in England trades unions have raised workingmen morally and intellectually, and have taught them a higher sense of their responsibilities. They have increased the prices and shortened the hours of labor; have educated workingmen to a knowledge of their common interest and common duty, and in every sense have raised the character of English workmen. Judge Rupert Kettle, in his work on "Strikes," says, respecting the trades unions: "They have promoted free thought and free action among the hand-working classes, and, moreover, have taught them to respect the law, and rely upon moral means for obtaining what they believe to be right. We have now no bloodshed, no rioting; scarcely an angry word in the bitterest and most protracted strikes. Although we owe this salutary change partly to the improved education and the higher moral tone among the laboring class, we owe it much more to the direct and immediate influence of trades unions." The British Quarterly Review says: "It appears pretty clear that unionism, by its influence, has, by slow degrees, altered for the better the condition and circumstances of British workmen." * * * * * * * * * * * *

The trades unions, acting under the old ban of illegality, have raised the wages and shortened the hours of labor in England. This, however, has been done too often at the loss of friendly feeling, comfort, and confidence between employer and employed.

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Strikes are a barbarous means of adjusting disputes, and much suffering and misery have thereby ensued to the men. The system of arbitration in disputes between employer and employed has, however, been inaugurated with great success. Arbitration was first proposed and carried out by Mr. Rupert Kettle, an eminent barrister, now judge of the Worcester county court. For ten years Judge Kettle has devoted his time to this subject, and has mediated with great success in many large disputes between masters and men in every part of England. Judge Kettle's services (for which he will accept no remuneration) are well known and appreciated by the workingmen, and whenever his decision has been against their claims they have accepted it loyally and thoroughly. Arbitration is now a principal platform of many of the leading trades unions. At the last annual conference of the National Association of Miners the following resolution was carried: "That the miners of the various districts in the association do all in their power to make arrangements with the employers to form boards of conciliation and arbitration, by which any disputes that may arise between both parties might be amicably settled without having recourse to the barbarous course of lock-outs." The system of trade arbitrations is, in fact, now nearly a national one, and Judge Kettle has also the satisfaction of seeing it accepted in a great number of industries in France, where his system was highly commended by the Comte de Paris in his book on the labor question; and in Germany, since its advocacy by the great social economist, Schultze Delitch, and the well-known Republican, Dr. Bertram.

The leaders of the trades unions in England have now, indeed, great power. Of Halliday, Burt, McDonald, and especially of Joseph Arch, it may be said, in the words of the Gaul Liscus to Cæsar, "There are some whose influence with the people is very great, who, although private men, have more power than the magistrates themselves."

The miners and mine owners of Great Britain were more reluctant in adopting arbitration for the adjustment of wages disputes than the other trade associations and their employers.

A large number of wages disputes, however, have, of late years, been amicably adjusted by means of arbitration, and the principle is rapidly commending itself to colliery owners and miners throughout every mining district of the United Kingdom. In the fall of 1874, during the prevalence of a strike in the West Yorkshire coal-field, the miners' agents called upon the colliery proprietors, at one of their meetings held in Leeds, and stated that the miners had agreed to submit the questions in dispute to the decision of a board of arbitration, and were willing to resume work at once upon the old terms as to wages. The mine owners agreed to this proposition, and a joint committee of miners and mine owners met and decided upon the plan of adjustment by the adoption of the following resolution:

That the miners having, through their representatives and referees, agreed to a general arbitration of the question, each side being at liberty to lay down its own basis before the arbitrators, this being accepted by the coal-owners, and that Mr. Shaw, of Leeds, barrister, and Mr. Cochrane, of Newcastle-on-Tyne, coal-owners, be appointed referees on the part of coal-owners; and Mr. Lloyd Jones (one of the referees appointed by the miners) having given an assurance that the arbitration could be completed within a fortnight, the men be allowed to resume work immediately upon the old terms as to wages, but if the award be not made within a fortnight, to take effect from that date.

A decision affecting 60,000 miners in the Durham coal field was at the same time reached, and thus were two great strikes brought to a close by friendly intercourse, which otherwise would have taken many weeks or months of enforced idleness to have settled. During the month of June of the present year the miners of Durham, by a vote of 20,000 to 16,000, decided to submit the question of a wages dispute to the decision of a board of arbitration, and another long and disastrous strike was thus avoided.

ARBITRATION IN PENNSYLVANIA.

The speech of Mr. Mundella, heretofore alluded to, attracted a great deal of attention at the time it was delivered in New York city, and at a subsequent meeting of the American Social Science Association, held in Philadeiphia, the question of arbitration was ably discussed in a paper by Eckley B. Cox, one of the leading coal-mining operators in the anthracite coal fields of Pennsylvania. In the spring of 1871 the miners and mining operators of the Schuylkill county coal fields agreed to submit the question of a wages dispute to the decision of a board of arbitration. The manner by which the dispute was submitted to the umpire was in the following form:

Articles of agreement made and entered into between the Anthracite Board of Trade and the Miners' and Laborers' Benevolent Association on the 11th day of May, 1871.

We agree to submit for the decision of the umpire, Judge Elwell, the question of wages for Schuylkill county for the year 1871, as follows:

First. The operators' proposition, as made in Philadelphia, namely: Basis at $2.50 at Port Carbon, with outside wages at $9 per week; inside wages $10 per week; miners by day's work $12 per week; contract work to be reduced 16¼ per cent. from present rates. The advance or decline of wages to 1 per cent. for every 3 cents advance or decline in the price of coal to be graded in the new prices thus formed. Wages not to be less than would be paid with coal at $2 at Port Carbon.

Second. The Miners' and Laborers' Benevolent Association's proposition: $3 at Port Carbon as a minimum, with wages as last year at that rate, namely: outside wages at $11 per week; inside wages $12 per week; miners by day's work $14 per week; advance to be 1 per cent. for every 3 cents advance on the price of coal.

We agree to the reference of the above proposition under the following conditions and terms:

1st. Each side to submit their proposition, with argument thereon in writing, to an umpire.

2d. Men to resume work at all the collieries immediately, the wages to be paid in accordance with the decision of the umpire.

3d. Prices shall be obtained from a list of all operators shipping over 20,000 tons of coal in 1870. Five operators shall be chosen from this list, by lot, on the 10th day of each month (if Sunday, then the preceding day), by four persons, two to be chosen by the Anthracite Board of Trade, and two by the Miners' and Laborers' Benevolent Association. The operators so chosen shall forward to each side of the committee chosen as above, on or before the 15th day of the month, a statement of the average of all sales of coal for the thirty days preceding, calculated at Port Carbon. They (the committee) shall meet on the 15th of the month (or, if Sunday, then the preceding day), and announce by circular the average obtained from the statements so presented, and the wages for the current month shall be based upon the average so obtained. For the month of May the operators to furnish prices shall be chosen on the 20th inst., and the prices shall be furnished and announced on the 25th inst.

Fourth. Provision is hereby made for future arbitration in the following manner:

1st. All questions of disagreement in any district, excepting wages, which can not be settled by the parties directly interested, shall be referred to a district board of arbitration, to consist of three members on each side, with power, in case of disagreement, to select an umpire, whose decision shall be final. No colliery or district to stop work pending such arbitration.

2d. If any question arises involving the whole county, a board of arbitration shall be chosen, consisting of five members on each side, with the same rights and duties as district boards.

Signed, on behalf of the parties hereto.

CHARLES M. HILL,
Secretary pro tem. A. B. of T.
WILLIAM KENDRICK,
President A. B. of T.
GEORGE CORBETT,
Secretary Schuylkill Co. Ex. Board, M. and L. B. Ass.
JOHN W. MORGAN,
President pro tem. Schuylkill Co. M. and L. B. Ass.
JOHN P. FRANCIS,
THOMAS LEONARD,
MICHAEL LAWLOR,
Committee.

DECISION OF THE UMPIRE ON THE QUESTION OF WAGES.

The umpire mutually chosen by the Anthracite Board of Trade of the one part, and the Miners' and Laborers' Benevolent Association of the other part, to decide the question of wages now at issue before them, having received and fully considered the written propositions and arguments of the parties, has decided and established the basis and rates of wages below mentioned, as in his judgment just both to the operators and to the men in their employ, viz:

Basis, $2.75 at Port Carbon.

Miners by day's work	$13 00	per week.
Inside laborers	11 00	" "
Outside laborers	10 00	" "

Contract work to be reduced 10 per cent. upon the prices paid under the $3 basis of 1869. Wages to be advanced 1 per cent. for every 3 cents advance in the price of coal at Port Carbon above $2.75 per ton, and to decline at the same rate when coal is below that price down to $2.25 per ton.

The articles of agreement under which the submission was made, together with the agreements and statements of the parties laid before me, are hereto attached.

WILLIAM ELWELL, *Umpire.*

POTTSVILLE, *May* 17, 1871.

This decision was accepted by the parties in interest, the miners at once resuming work, and it was believed that a long era of peace had at last dawned upon that troubled coal region. Work continued without interruption till the following September, when the outside laborers of the Thomas Coal Company made a demand for an advance of wages corresponding to the basis of the preceding year. This demand was a flagrant violation of the award of the umpire, and was without the shadow of excuse, yet the coal company immediately acceded to it, and it was soon followed by similar demands at other mines. The more honorable portion of the workmen of the county deplored the want of faith on the part of their fellows, but the violation of the contract produced such a feeling against the miners that no further attempt has since been made to adjust a wages dispute in the anthracite coal region by arbitration.

The plan by which wages were adjusted in this coal field after the failure by arbitration was the result of a joint meeting of a committee of the miners and mine operators held in Pottsville, on the 6th of January, 1872. This committee, consisting of members of the Anthracite Board of Trade and Workingmen's Benevolent Association, settled on the following basis and scale of prices for the year 1872:

First. Wages to be fixed on a basis of $2.50 per ton for coal at Port Carbon, with outside labor at $10 per week; inside labor, $11 per week; miners, by day's work, $13 per week, and contract work at a reduction of 8¼ per cent. below the basis price at $2.75 for 1871.

Second. All advance and decline to be at the rate of one (1) per cent. for every three (3) cents advance or decline in the price of coal, with the understanding that when coal reaches $2.75 and upward, the wages shall be the same as at the same prices of coal in 1871: *Provided,* That wages shall not be less than the $2.50 basis price for more than two months out of the year, and that those two months shall be between the first of April and December 31, and that in those two months the wages shall not be less than at a $2.25 rate.

Third. Prices shall be obtained from a list of all collieries shipping over the Philadelphia and Reading Railroad over thirty thousand (30,000) tons in 1871, and none shall be chosen a second time until the list is exhausted. Five operators shall be chosen by lot, from this list, on the first day of each month (if Sunday, then the day preceding), by four persons, two to be chosen by the Anthacite Board of Trade, and two by the Miners' and Laborers' Benevolent Association. The operators so chosen shall be required to forward to each side of the committee chosen as above, on or before the tenth of the month, a statement of the average of all sales of coal (excepting pea coal) for the preceding month, calculated at Port Carbon. The committee shall meet on the tenth of the month (or if Sunday, then the day preceding), and announce by circular the average obtained from the statements so presented, and the wages for the current month shall be based upon the average so obtained. For the month of January it is agreed that wages shall be paid on the $2.50 basis.

Signed at Pottsville, Pennsylvavia, on the sixth day of January, 1872, on behalf of the parties hereto.

Wm. Kendrick,
J. K. Sigfried,
Geo. W. Cole,
J. L. Nutting,
Charles M. Hill, Jr.,
For the Anthracite Board of Trade.

John J. Williams,
James Ryan, Jr.,
Wm. J. M'Carty,
Michael Farrell,
John H. Dodsworth,
For the Miners' and Laborers' Benev. Assoc'n.

This agreement was faithfully adhered to by both parties, and was ratified at the January meeting in 1873. On the following January, however, the operators' committee having proposed a reduction of 20 per cent. on the basis, the miners' committee promptly refused to accept it, and a five months' strike followed, the miners finally yielding to the proposition and resuming work under it. This plan of adjusting wages still prevails in the anthracite regions. The following scale of prices now rules: When coal is worth $2.50 at Port Carbon, the point where the trains are made up as the cars come from the mines, first-class inside laborers about the mines get $1.50 per day, and second-class laborers $1.35 per day. Inside laborers not employed in digging coal get $9 per week. Miners digging coal by the day, and not by the ton, get $11 per week, miners employed in digging by the ton getting 40 cents per ton. In no case can wages fall below these figures. If coal will not command $2.50 per ton at Port Carbon, the mine owners must suspend operations at the mines until it will command it, or sustain all the loss themselves.

The sliding scale continues so arranged that when coal rises above $2.50 at Port Carbon, the miners receive one-third of the advance, and when, being above the basis, it falls in price, the miners sustain one-third of the fall.. The scale of prices is adjusted every three months by a joint committee of the miners' union and the coal exchange. This plan of adjusting wages is very satisfactory to the miners, and may be said to be now an unwritten law. The only possible danger of a strike under it is when a change is proposed in the basis at the beginning of the year. If, when a question of this nature arises, both parties would renew the effort of 1871, to settle the dispute by a board of arbitration, and the miners were possessed, as they surely are, of sufficient honor to abide by the award of the umpire, the question of strikes in that great coal field would be solved. Surely, as Mr. Mundella says, "What can be done in Old England can be done in New England, and what can be done in either can be done in the iron and coal districts of Pennsylvania or anywhere else."

ARBITRATION IN OHIO.

Only one effort has been made to settle a wages dispute by arbitration in Ohio, and, as in the Pennsylvania case, it resulted in failure, though the fault was not that of the miners, but of one of the mining companies. The operators of the Tuscarawas Valley proposed, at the beginning of December, 1874, to reduce the price of mining from ninety to seventy cents per ton. The officers of the Miners' National Association, desirous of avoiding a strike, and of establishing boards of arbitration for the settlement of wages disputes, proposed that a joint conference of the operators' and miners' representatives be had, to discuss the question in dispute. This committee, which met in the city of Akron on the 17th of December, unanimously agreed to refer the dispute to the decision of a board of arbitrators. The following is the resolution adopted at the meeting:

> *Resolved,* That the present differences in prices between the operators and miners in the Tuscarawas Valley be submitted to a committee of three operators and three miners, who shall elect an umpire, whose decision shall be final and binding on both parties.

The committee consisted of Messrs. Hanna, Wagoner, and Loomis on behalf of the operators, and Messrs. Thomson, Pollock, and Graham on behalf of the miners. At the suggestion of the miners' representatives, the venerable Judge Andrews, of Cleveland, was chosen umpire. The matters in dispute were ably and fairly discussed, neither party wishing to take any advantage. The decision of the umpire was as follows:

> The producers and miners of coal in the Tuscarawas Valley, having submitted for my determination the price that, in the present condition of the coal trade, shall be paid for mining coal of standard thickness in said Valley (said submission being made with a view to equalize mining in said Valley with mining in competing districts), and the said parties, by their respective committees, appeared before me, at the office of Rhodes & Co., in the city of Cleveland, on the 22d day of December, A.D. 1874, and being fully heard in the premises, and their statements and the evidence therewith submitted having been duly considered by me, I do hereby award as follows, to wit:
>
> *First.* That the producers in the Tuscarawas Valley shall reduce the price of powder, oil, and rent, furnished by them to the miners, so as to make them correspond with the prices charged for the same respectively by producers in the Mahoning Valley.
>
> *Second.* That the said producers in the Tuscarawas Valley shall pay the miners for every twenty-one hundred pounds of raked coal, such as is now given, of standard thickness (that is, four feet and over), the sum of seventy-one cents.
>
> (Signed) S. J. ANDREWS.

The above award was accepted and subscribed by the miners' representatives, the operators pledging themselves to pay for all "extras"—deficiency work—on the basis of 1870. For the purpose of adjusting the prices of deficiency work, another meeting of the representatives of the operators and miners of the valley was held in Massillon on the 22d of January following, the operators being represented by Messrs. Loomis, Weaver, Brewster, Hanna, Foultz, and Millhoff, and the miners by Messrs. Kirkly, Jacobs, Cummock, Trent, Young, Archibald, and Penburthy. The following schedule of prices for deficiency work was agreed to by this committee:

1. To pay five cents per ton extra for mining coal on every three-inch drop under four feet.
2. For turning rooms, two and a half to three dollars.
3. To pay three dollars for break-throughs any distance under nine feet, and over nine feet two dollars per yard for the whole distance.
4. Wet entries and wet rooms to be paid a fair compensation, and to be left to the agreement of pit boss and the men, and horsebacks to be paid for as heretofore.
5. Break-throughs, from entry to entry, fifty cents per yard less than entry-driving, for three yards or less, and on the distance over three yards, entry price.
6. In all cases where the roof is rotton and bad, and slate and dirt come down unavoidably, the man shall be paid five cents per ton on the coal for every six inches. But where the roof is good and this occurs from carelessness or neglect on part of miners, no compensation shall be allowed. This to be determined by the pit boss.
7. Entry-driving and day-work by miners to be reduced in the same proportion as mining.
8. In all cases where it is not necessary for the producer to work that part of the mine where deficiency work occurs, he may do so, on application of the miners, by special contract.
9. The price of powder to be four dollars per keg, and oil one dollar and twenty-five cents per gallon; it being understood that the men shall have the privilege of buying each wherever they choose.
10. In cases where house-rent has been advanced in proportion to previous advances in mining, a corresponding reduction shall be made.
11. House coal to miners at lowest wholesale price.

All the miners resumed work under the above arrangement, except those of the Crawford Coal Company. The miners in the employ of this firm wished to employ a check-weighmaster, a right given them by the mining law, and a right which is fairly theirs without any law on the subject. The miners wished to make no interference with the weighing of the coal or with the scales, but simply wanted to employ and pay a man to see their coal fairly weighed. The company peremptorily refused to allow this to be done, and stopped the mine; in other words, struck against the mining law. This coal firm urged the other operators to sustain them against the demand of the miners, but they refused to do so, asserting that it was a matter with which they had no concern, and was, moreover, against the law of the State. The superintendent of the Crawford Coal Company then told the miners of that firm that if they would withdraw their claim for a check-weighmaster the company would raise the price of mining to eighty cents per ton, being nine cents advance over the award of the umpire. This proposition the miners eagerly accepted.

The workmen in other mines of the valley, who had resumed work under the award of Judge Andrews, seeing the Crawford Coal Company voluntarily raise the price to eighty cents per ton, demanded to be placed on the same footing. The officers of the Miners' Union advised the miners to respect the award of the arbitration board, and to continue work at the seventy-one cents, but no attention was paid to such counsel. The majority of the miners had received the decision of the board of arbitration in a sullen spirit, alleging that the reduction of nineteen cents was uncalled for and unjust. And when they saw one leading coal company voluntarily disregard an award in favor of the operators, and advanced wages nine cents on the ton, they became confirmed in this view. All the companies conceded to the demands of the miners, and the work of the arbitration board was thrown to the winds. The officers of the Miners' Union were roundly berated by the miners for not securing better terms.

AMELIORATION OF MINERS.

In former reports I have recommended the establishment of benefit funds at the mines in the interest of the crippled and the infirm, and the orphans and widows of miners killed in the mines; also the establishment of night-schools and reading-rooms. These are matters which properly belong to the miners and mine-owners, and in which both should take a common interest. All movements of this character beget mutual confidence and respect. These questions are discussed at length in the Centennial address of the Hon. Abram S. Hewitt, President of the American Institute of Mining Engineers, delivered in Philadelphia June 20, 1876. Though Mr. Hewitt's remarks refer especially to the anthracite coal regions of Pennsylvania, they are equally applicable to every coal region in the Union. I copy from this address as follows:

> To insure continuous operations, the best relations must exist between the corporate owners and the laborers in their employ. It is notorious that throughout the coal regions these relations have been of the most unsatisfactory character, resulting, at often-recurring intervals, in strikes and lock-outs, which have no redeeming feature, but, on the contrary, have raised the price of coal to the consumer, have impaired the dividends of the owners, and have reduced the working men and their families to a condition of suffering and demoralization appalling to every well-wisher of his race. It is fortunate, therefore, that the interests of all classes concur in the prevention of these destructive and demoralizing collisions, and that the owners of the property, for their own self-protection, will be driven to remove the causes which have produced them. It is idle

for them to expend their capital for the best machinery, for the highest skill, for the most economical transportation, unless they can, at the same time, insure a continuous production from a contented laboring population.

This they have it in their power to do. If the same spirit of sacrifice which has sent out our missionaries into every heathen land had been shown in the coal regions, and the same efforts had been made to establish and maintain the school-house, the church, and, above all, the Sunday-school, which have borne such fruits elsewhere in this broad land; if the hospital for the sick and the comfortable refuge for the unfortunate had been carefully provided; if reading-rooms and night-schools and rational places of amusement had from the outset been maintained for a growing and restless population, the coal regions to-day might have been a paradise upon earth instead of a disgrace to civilization. And here it is that this new power of concentrated management can exert itself with sure and absolute success. The appropriation of a few cents per ton on the coal mined to the work of improving the moral and intellectual conditions of the miners and their families will, in a time incredibly short, change the whole face of society in the coal regions.

To be effective, however, this consecration of a fixed amount on each ton of coal sent to market must be as absolute and final as that portion of the proceeds which is devoted to pumping the mines or driving the gangways. It must not come from grace, but from a sense of duty involved in the ownership of property, and dictated by a wise regard for its preservation and permanent value. Even if this percentage were added to the price of the coal, the addition would not be grudged by the public; but in fact no such addition could possibly occur, as there is no surer way of promoting economy in the cost of production than by improving the social condition, the self-respect, and the intelligence of those who are engaged in the work of production, which thus becomes continuous and systematic. Until the great companies thus recognize the duties, the responsibilities, and the opportunities for good which are offered by the new social development, which has rendered their existence a necessity as well as a possibility, they must not complain that they are regarded with distrust, and as enemies, both by the public which consumes their products, and by the working classes who see in them only grasping employers without a conscience. What individual owners could not do, it is easy for these great companies to put in practice; but the effort must be as earnest and serious as is the business of producing the coal and getting it to market. The very best talent must be secured for the organization and management of the various agencies necessary for the moral, intellectual, and social improvement of the working classes, who must be themselves associated in the administration of the fund created and expended for their benefit. Five cents per ton would produce an annual revenue of over $1,000,000 applicable to this necessary and noble use, and five years of intelligent and conscientious administration would convert what in some regions has been aptly termed a "hell upon earth" into a terrestrial paradise, which would be the pride and the glory of the new world.

"Is not that government both unjust and ungrateful," asks Sir Thomas More, "that is so prodigal of its favors to those that are called gentlemen or goldsmiths, or such others who are idle, or live either by flattery, or by contriving the arts of vain pleasure; and on the other hand takes no care of those of a meaner sort, such as plowmen, colliers, and smiths, without whom it could not subsist?

"But after the public has reaped all the advantages of their service, and they come to be oppressed with age, sickness, and want, all their labors and the good they have done are forgotten, and all the recompense given them is, that they are left to die in great misery. The richer sort are often endeavoring to bring the hire of laborers lower, not only by their fraudulent practices, but by the laws which they procure to be made to this effect, so that though it is a thing most unjust in itself to give such small rewards to those who deserve so well of the public, yet they have given those hardships the name and color of justice, by procuring laws to be made for regulating them."

Although I quote from the *Utopia*, let it not be supposed that there is any thing Utopian or impracticable in the proposition which I have advanced. It seems to me to be the next great step to be taken for the amelioration of the condition of mankind. The law of diffusion which thus far has governed the progress of the human race toward a higher and better plane of civilization, has at length made an effective lodgment in the domain of capital, whereby it is rendered capable of infinite division without impairing, but in effect improving, the economy and force of its administration. The reproach that "corportions have no souls," must and will be next removed, so soon as the beneficent possibilities inherent in these agencies shall be generally recognized, and those who are called to the management shall see that because capital is aggregated, the primary law on which all property rests, that it is a trust to be administered for the public good, loses none of its force, but can, in reality, only assert itself in all its vigor when concentrated management is brought to bear upon great aggregations of capital. Man did not become a "living soul" until God breathed into him the breath of life. So corporations are mere machines until they are inspired by the associated conscience of society, to which they can give ready and effective expression, and I look for this expression first from the great coal companies, because their property and their peculiar organizations make it easy as well as profitable for them to put in practice the fundamental idea, that a fixed portion of the proceeds of industry should be invariably devoted to the social improvement of those who labor directly for its development.

If the seed here dropped should take root, as I pray and believe it will, then, indeed, will the country and world have reason to rejoice at the industrial development of the last hundred years, and the celebration of this centennial be the dawn of a better day for the patient sons of toil, who, let it be confessed with all frankness and humility, have not yet been endowed with their fair share of the good things of this goodly earth.

BENEFIT FUNDS IN PENNSYLVANIA.

The only instance of which I am aware of any movement having yet been inaugurated in any mining region of the Union for the establishment of benefit funds at the mines is that of the Wilkesbarre Coal Company. After the occurrence of the Avondale catastrophe, this company and their employés established a benefit relief fund at the mines. The company gave the yield of the mines for one day, and the miners each gave a day's work, the amount raised being $6,000. Since that time this fund has been constantly and rapidly accumulating, every new miner giving the first day's work to the fund. The fund is deposited with the coal company, who pay 6 per cent. interest on the money. The trustees are selected by the miners.

Since the establishment of this fund it has been changed in order to include all the mines owned by the Philadelphia and Reading Coal and Iron Company, and more liberal provision has been made for families whose heads have been crippled and killed in the mines. The following regulations are now in force at all the collieries operated by the Philadelphia and Reading Coal and Iron Company:

> "Should any person, after having been in the employ of the company for upwards of one month, meet with a fatal accident in the discharge of his duty as a workman, his family shall be entitled, for one year from date of death, to the following benefits, provided that no person entitled to said benefits shall, directly or indirectly, engage during said time in the sale of intoxicating liquors:
>
> "1. Thirty dollars to be paid for funeral expenses.
>
> "2. Three dollars per week to be paid for maintenance of widow.
>
> "3. One dollar per week to be paid for the maintenance of each orphan child under twelve years of age."

The amount paid in since the organization of the fund in 1869 has been as follows:

In 1869		$6,000 00
In 1870		5,030 52
In 1871		7,425 36
In 1872		8,278 01
In 1873		12,237 64
In 1874		26,373 28
To October, 1875		25,901 25
		$91,246 06
Interest paid by company to October 1		1,971 26
Total		$93,217 31
Amount contributed to Avondale fund, 1869	$1,000 00	
Amount of orders drawn to October 1, 1874	40,336 41	
Amount of orders drawn from October 1, 1873, to October 1, 1875	25,545 14	
		$66,881 55
Balance in treasury October 1, 1875		$26,335 77

The above figures show that the amount of $66,881.55 has been paid out in benefit funds in the five years in which the organization has been in existence, and that there are, October 1, 1875, $26,335.77 in the treasury.

In addition to the amount of good done to hundreds of families by the operation of the above fund, its existence can not otherwise than result in a kindlier feeling between the miners and operators. When an accident occurs in many districts causing loss of life or serious personal injury to miners, at the same time destroying mining property, the miners of many districts affirm that the first question the mine-owner or his superintendent asks, on hearing of the accident, is, "Are the mules safe?" and they declare that mine-owners care more for the safety of a mule than a miner's life.

Many organizations of similar purport exist in the mining districts of Great Britain, but the oldest and the best associations of this character are the miners' unions of Germany. These unions date back to the thirteenth century. They are now spread over every country of continental Europe, and they receive corporate rights from government. In the miners' unions of Prussia, when a miner is injured by accident at the mines, or is overtaken by disease from natural causes, he receives assistance from the fund of the union during the whole time he is laid off work; also medical attendance free of cost, and should he die the union pays the funeral expenses. When a miner is so seriously hurt or crippled as to prevent him from further pursuit of his calling, or when he has become too feeble by disease or by age for work, he draws a life pension out of the union fund; and after his death his widow receives a monthly pension till she marries again, and all his children receive pecuniary assistance until they arrive at the age of fourteen years.

There are two classes of members in these associations—permanent members and temporary members. The latter only possess personal rights, while the former, after five years' membership, have their rights extended to all their family. Members forfeit their rights in the union when they refuse to pay their regular contribution, or when they leave the mine without permission. The contribution fees are equal to 3½ per cent. of the mine earnings of each member. The mine owners are also required to pay 1 per cent. of the yield of the mines. The funds are under the control of the government inspectors of mines, who are made responsible for defalcations, and are charged with seeing that the members are justly dealt with.

The care which the government of Germany has exercised over the life, health, and comfort of the German miner, has made him proud of his profession, and few of them ever leave the mines. There are two thousand Germans in the coal mines of Ohio, and there are not more than five or six who followed the calling of a miner in fatherland.

CERTIFICATED ENGLISH MANAGERS.

Since the passage of the mines regulation act of 1872, all persons desiring to become underground managers of mines in Great Britain are required to appear before a board of examiners, and receive a certificate of competency. No amount of practical experience as a miner will alone suffice; the examinations are very pointed, and none but those who can pass a satisfactory examination before the board are given certificates. The following were questions put to applicants for certificates by a board of examiners in Edinburgh, Scotland, in November, 1873:

When underground workings are approaching old wastes, of which no plans have been kept, what special dangers are the workmen exposed to, and how would you provide against them?

State shortly the general rules as to the use of gunpowder or other explosive material, in mines where inflammable gas has been noticed.

What is the requirement of the act as to the number of shafts in use at each mine, and state shortly the exceptions to it that may be allowed.

In mines where there is inflammable gas, what special precautions are to be observed by the workmen and by those in charge of the mine?

Give a short statement of the requirements of the act regarding man-holes or places of refuge on underground roads.

What limitations does the act impose in the employment in mines of young persons between twelve and sixteen years of age?

Explain why artificial ventilation is more reliable than natural. Describe the different modes of producing artificial ventilation.

For an extensive but shallow working, would you adopt a fan or a furnace? and give your reasons.

How do you measure the velocity of an air current, and at what velocity would you have air traveling through the workings?

Give your reasons for making air-courses as large as possible. Explain the advantage of splitting the air.

Describe the barometer, and explain how it indicates the atmospheric pressure. What is a water-gauge, and of what use is it?

Sketch what you consider a good furnace for a pit sixty fathoms deep, with one hundred men, giving its dimensions and relative position to the shaft.

Under ordinary conditions as regards gas, what quantity of air would you have circulating in a pit with one hundred men, and what is the least dimensions you would have the air-courses? Give observations regarding the necessity of having the air-course uniformly large.

Explain the ordinary conditions for adopting the long-wall and the stoop and room working.

In a seam having a dip and rise of one in six, and the direction of the plane of the coal being to the full rise, sketch what you consider a good form of long-wall working for it, having regard to the ventilation, direction of the drawing-roads, etc.

Under the same conditions, give sketch of a stoop and room working by which the greatest percentage of the seam can be got out.

In a four-foot seam of coal eighty fathoms deep, what size would you make the pillars, having regard to the ultimate extraction of the greatest quantity of coal, combined with safety to the workmen?

Give a rough section showing the different seams of coal in your district.

Under ordinary conditions as regards roof and pavement, give your observations on the cost of working a four-foot seam of coal by stoop and room, and a two-foot seam by long-wall, embracing the oncost necessary in each.

Sketch what you consider the best form of a shaft one hundred fathoms deep, for an out-put of three hundred tons a day, including ordinary provisions for pumps, and showing arrangement of slides and cages, with dimensions.

Explain how you would prevent water met with near the surface from getting into the shaft.

How many gallons are there in twelve hundred tons of water, and describe the general arrangement and size of pipes for lifting that quantity daily from a pit eighty fathoms deep.

Describe the class of engine best adapted for the above work, size of cylinder, stroke, and strokes per minute.

Explain fully the advantage in a deep shaft of having a series of lifts instead of one long lift to the surface.

Explain the action of a syphon, and its use and application in draining mines.

State the various methods you know of pumping water out of a dip-working.

Describe the best kind of boiler for the safe and economical production of steam.

Explain the forces acting on a self-acting inclined plane. Compare the friction of ordinary tubs on tram-rails with the friction on a well made railway.

Under the usual conditions of tram-rails and tubs, what is the flattest gradient for a self-acting inclined plane three hundred fathoms long, to pass one hundred tons in eight hours? Sketch the best arrangement of it at the top.

Explain the best mode of drawing coals along a level road, or one not dipping sufficiently to take away the rope.

Explain why conical drums are necessary in deep shafts.

Whether are chains, wire-ropes, or hemp-ropes preferable, and give your reasons. Given the breaking strains of a rope, what is a safe working lode for it?

State from your experience what is the cost of haulage underground per ton per mile. How does it compare with the cost of a mineral railway above ground? Give your observations on the different modes of haulage known to you, and how you think they might be improved.

Accidents frequently happen on headings where the loaded tubes are taken down with snibbles, by the full tub running into the one before it, or into an empty one coming up; how would you remedy this, and still retain the use of snibbles?

In speaking of machinery, what is meant by horse-power?

Sketch on paper as near as you can the following bearings of a survey 82° N. E., 68 links, 51° S. E., 95 links, 63° N. E., 79 links, 20° N. E., 97 links, 35° N. W., 87 links, 87° N. W., 140 links, 52° S. W., 140 links, and 48° S. E., 85 links.

Describe the compass, and explain the circumstances under which it is unreliable.

Explain what is meant by the scale of half an inch to a chain.

Describe the process of surveying underground.

Describe how you would plot the same survey on paper, and name the instruments you would require to use.

Why is it necessary to make deductions from the measurements to the rise and dip in steep workings, and how would you find the correct measurements?

Suppose you were driving toward an old waste which is shown only on a plan twenty years old, explain the precautions to be taken as regards the meridian.

Add together 507 tons 13 cwts. 2 qrs. 12 lbs. 1670 tons 15 cwts. 1 qr. 8 lbs. 47 tons 14 cwts. 3 qrs. 14 lbs., and 498 tons 9 cwts. 2 qrs. 7 lbs.

How much would be required to pay seventy-five men a fortnight's wages at the rate of 27 s. 4¼ d. each per week?

How many cubic feet of air will pass per minute through an air-course 5 feet by 7 feet when the air current is traveling at the rate of 20 yards in 15 seconds?

What weight of material will have to be raised in sinking a shaft 15 feet by 5¼ and 40 fathoms deep, supposing it averages 130 lbs. per cubic foot?

How many gallons of water will be pumped in an hour by an engine making eight strokes of 7 feet each per minute, the diameter of the pump being 15 inches?

How much power would it require to send 10,000 cubic feet of air per minute through an air-course having an area of forty square feet, and how much would the power require to be increased to do it if the area was only twenty square feet?

CLEVELAND, OHIO, *November* 2, 1876.

HON. ANDREW ROY, *Inspector of Mines for the State of Ohio:*

DEAR SIR: I gladly avail myself of your invitation to state my views on the existing relations between capital and labor, the causes of the numerous strikes; the growing discontent on the part of the workmen, and what appears to me likely to improve those relations, in so far as our mine-owners and miners are concerned.

The unhappy existence of real and seemingly deep-rooted discord between employer and employed around our coal mines is to be deplored by every friend of humanity. The cause may be stated, in brief, as the natural outgrowth of the wages system itself. A workman paid wages for his labor only, and having none of the confidence of his employer, knowing nothing as to whether the price paid is the source of loss or gain, is not likely to consider necessary changes in prices with that nice judicious discrimination that reaches proper conclusion. Yet this is really expected of labor by the public, and the purchasers of labor as well.

"The law of supply and demand," some people say, "should be allowed to regulate wages, and if this were so, there would be no clashing of interests, apparently distinct, but really identical. Capital and labor," they argue, "are really co-partners in all enterprises, and should work together in perfect harmony. There should be no strikes, no wrangling, no grievous and costly disputes, but all move on smoothly, bending cheerfully to whatever circumstances are presented by the vibrations of this great law." This is very good moralizing, but every practical mind knows that what political economists term the law of "demand and supply" has very little to do with fixing the rate of wages in general, and in many cases is entirely under the control of rings and corporations. Beside this, every man of experience and observation knows that no such thing as "co-partnership" in any sense of the term exists between the employer and the employed. These people reason from what they think *should* be, but not what is so.

It rarely happens that our coal miners get an advance in wages unless they strike for it, or show a thorough determination to strike, no matter what condition the labor market be in. Through the efficacy of trades unions, in certain districts, workingmen also receive much more money for their labor than in places where no unions exist, yet both compete in the same markets. Combinations, under various names, for regulating the sale of all manner of products, exist in our cities among manufacturers. "Coal exchanges," "stock exchanges," "produce exchanges," and numerous other exchanges, or associations, all more or less control and fix the prices for almost every variety of goods and wages. These combinations, in a large number of cases, arbitrarily control the supplies, and, therefore, put their own prices upon what the public requires to buy, and, at the same time, determine the rates of wages to the workers.

"Company stores," usually denominated "truck shops," many of which are in this State, are the cause of much discontent. This is a business where the operator and the miner ought, in reality, to be partners. A mine-owner, of any standing, can start one of these stores and not have one dollar invested therein. In nine cases out of ten this is the condition upon which they are instituted. The goods are bought on thirty, sixty, or ninety days' time. Where those stores exist the miners pay for the goods they get in labor. That labor is performed in advance of obtaining the goods in this way: The miner, or other worker, digs so many tons of coal to-day, and so soon as the "bank boss," who keeps tally of the workman's produce or time, turns in his account in the evening to the clerk the workman can go and get an order on the store-keeper for goods to the amount of his earnings. I do not know that they give orders for any thing in excess of what is actually earned. The rule is, at these stores, to charge prices considerably higher than the same goods can be purchased for at other places. Men are compelled to buy their goods at whatever prices are asked, and a refusal to do so is punished by discharge.

In England the store plan of payment became so oppressive, and led to such pauperism among the classes upon whom it was practiced, that it was found necessary to prohibit it by statute law years ago. All the abuses practiced there are in vogue, where we have stores, in this country at the present time, and the same terrible consequences following in its wake. The victims are suffering from its privations, and it is one prominent cause of complaint and discontent among the miners where it has become the practice, and many miners now demand that the legislatures of our respective States should step in and protect them, as has been done in the country stated.

The *truck* question, however, is not quite general in its application, as many mining districts have no such cheating institutions around them. Where fair-dealing employers, or those inclined to be fair, have not got stores of this kind, and have to sell their coal in the same markets with those who have, it is simply impossible for them to run their mines in competition with the store dealers, all other things being equal, by doing justice every other way toward their workmen. Those having the stores, reaping the double profits, that on production and consumption, they are able to run the others out of the business, or into bankruptcy, in a very short time. Either horn of the dilemma is a disagreeable one to most men, and, to supply the wants, a system as bad as the "store order" or truck plan is resorted to, which is "docking," or giving "short weight" for the coal mined to the miner. The law makes a grocer or other dealer who uses false weights or measures liable to heavy pains and penalties. A person buying in any store goods of any kind can see them weighed or measured, if he has any suspicions. The party selling may have unfair scales or small measures, but he will not object to the purchaser looking on and seeing for himself that full justice is meted out. The purchaser has, also, the other remedy of taking his goods and testing them on other scales or measures, and, if he finds he has been wronged, he can apply to the proper officer, under the law, and have the offender punished. Not so with the coal miner. He goes into the mine, mines and loads his coal upon his car, hands it to the representative of his employer, the purchaser of his labor, and that representative, in the absence of the seller, and on a scale of the buyer, gauges or weighs the material of the coal miner, and sets down figures to his credit that may or may not be correct. The car in which the coal is measured may be just to an inch, the scale may be true that is in use, but where the man who has produced the article, in himself or representative, is excluded from witnessing the operation, it can not fail to give rise to suspicions, charges of cheating, discontent, and strikes of resistance against the perpetuation of such an unjust and monstrous practice.

Next to the question of wages and ventilation, no other subject has given rise to more strikes than the question of just weighing and measuring of the coal when sent to bank.

If there is one thing more than another in which the miners command the sympathy, support, and approbation of their fellow-workmen, whether leaders or followers, in their efforts to overthrow the existing condition and substitute a better, it is in this matter of weighing and measuring. I do not know of any district in the country where strikes have not occurred, time and again, over this question. It is hardly possible, at present, to go into a coal-producing district, where the right to measure the cars, test the scales, and place a check-weighman of their own upon the tipple, is accorded the workmen. Though hundreds of strikes have had their origin in this cause, yet but very few places enjoy the privilege of exercising what should be an indisputable right.

Bad ventilation in the mines is an irritant of no mean magnitude. A coal mine, it is generally admitted, is not a very inviting place for any human being to "earn his bread by the sweat of his face." To people raised to man's estate before seeing one, and having the apprehension common to our species, it would be the direst punishment, even as an atonement for crime committed, to compel them to work there. The dark, gloomy surroundings, the dangers seen and unseen, every where present, are things our whole nature shrinks from as we would flee from a pestilence.

These causes, hastily noted, are the springs, so to speak, of the general discontent among the miners that so frequently manifest themselves in strikes. To them may be added the growth of intelligence and the steady reaching after a higher and better position in the scale of civilization. The wants of miners twenty years ago were fewer than they now are, and they are no exception in this matter. As we become better educated our wants grow—and this is in harmony with the teachings of all history. As people become civilized, intelligent, and refined, their desires increase, and so, also, the means to gratify them. The savage has few wants above the brute, and his ability to supply them is correspondingly limited.

Just how far the Legislature may be warranted in interfering in questions of wages disputes, or whether it should do so at all, is a nice question. Arbitration, under the Mundella law, in Great Britain, has worked admirably for some years. This law provides merely the rules under which questions referred to a board for adjustment will be conducted, and confers special powers upon the umpire, who is the court before whom such cases are argued. To enforce the awards or decisions there is no law. It is a matter of honor on the part of operators and operatives to accept the verdict and abide the consequences. In no instance, however, have the miners or their employers, of that country, failed to adhere to the decisions rendered; and in the last three years alone the system must have saved an immense amount of capital on the one hand, and money, poverty, and misery on the other. A similar law could be profitably enacted by every State in this Union. Some friend of progress might do good service to the State if he would draft a bill to this end and work for its enactment by both branches of our Legislature.

Labor has no faith in the disposition of capital to treat it fairly in any of its rights. In fact, it believes capital to be a tyrant and an oppressor, having no regard for the human composition of the workman, and disposed to extend it no more consideration than it does machinery and cattle. Capital, on the other hand, has no faith in the intelligence, honesty, or good faith of labor. This is the situation in general, and the desire of the exceptions in both interests is to encourage ways and means to close up the chasm. If strikes are to be abolished, and a better feeling planted that will endure, drawing capital and labor into a closer bond of fellowship, intelligent means must be used to that end. It is not enough to content one's self with the statement that this feeling exists on the part of the workmen because demagogues and mischief-makers inspire and keep it alive, and it must be crushed out by force. That has not been an efficient weapon in the Old World, with many more favorable advantages to make it a success. Capital and labor have fought many a well-contested battle for supremacy in the chief countries of Europe, but all were in vain, except to demonstrate to each other the folly of fighting over causes that should have no existence. So, after many years of Kilkenny-cat warfare, they, through their respective unions or associations, got together and arranged, where there were real grounds for complaint, to wipe them out by courts of conciliation and arbitration, taking care to avoid any stoppage of work pending negotiations. Thus not only is there growing up a better understanding between capital and labor, but each is making more money, and the nations encouraging this system are strengthened in point of wealth, and every other way one can imagine.

The cost of the militia service at Massillon last summer will come in for consideration at the next session of the Legislature. It will doubtless be a nice sum. Perhaps the occasion demanded the expenses, although I do not think so. Be that as it may, it should be a powerful argument in favor of the Legislature investigating the subject with a view of preventing in future, if it be possible, as I believe it is, such calamitous occurrences. With legislation to enforce just weighing and measuring of the miner's material, the abolition of truck-store pay, the encouragement of boards of conciliation and arbitration for the adjustment of all questions of dispute, and efficient inspection under the mines act, the writer is fully convinced a repetition of such events as the Tuscarawas Valley strike would be few and far between. Much could also be done by mine-owners and operators by the encouragement of a higher standard of education and morality among their men. This can be done in many ways at little cost. A comfortable reading-room in many of our mining villages could be sustained and do good service if the initiative was but taken by the employers. Once started, the workmen would doubtless make such institutions self-sustaining, and the influence they would have, in every respect beneficial, would be incalculable in dollars and cents.

Trusting the day is not far distant when labor and capital will work on principles more harmonious and just than at present; when each shall receive its proper proportion of the joint earnings of both; and no strike find a place, or be required in the adjustment; and to produce such a result, no nobler or holier subject could engage those chosen as the law-givers of any people,

I remain, very truly yours,

JOHN JAMES,
Secretary Miners' National Association.

WASHINGTONVILLE, COLUMBIANA COUNTY, OHIO,
November 4, 1876.

HON. ANDREW ROY, *State Inspector of Mines, Columbus, Ohio:*

DEAR SIR: When you delivered your address before the Washingtonville Miners' Institute, in August last, on bad air and its influence on the habits of miners, you stated that any miner who desired to might write you a communication on the causes of miners' strikes, or on any matter relating to the miners' interests, and you would publish it in your report, and I accept your offer. I could not agree with you as to defective ventilation being at the bottom of all our trouble. I think there are many real grievances beside bad air which cause strikes. The public generally charge the "leaders" among miners as being the cause of all trouble at the mines. I have found, with few exceptions, that the more intelligent and active men in our ranks are opposed to strikes, and in many instances that I know of the leaders have remonstrated against them. Miners, like other toilers, are sensitive to wrong. When they think their rights are encroached upon they use the only power of redress they have—that is, they strike.

A mine manager issues an order that henceforth miners shall be paid for no more than thirty-six bushels per car, and that on all cars overweighing thirty-six bushels the surplus shall be confiscated by the company. Formerly forty-one bushels were paid for if forty-one bushels were sent out, few cars weighing that amount, however, and not more than forty per cent. weighing thirty-eight bushels. I was sent to the company to remonstrate against this new condition of weighing, and all the answer I got was, "Do as you please; we will pay for no more than thirty-six bushels." This answer caused a strike. Understand, if we sent out thirty-five bushels we got paid for that amount, but if we sent out forty-one bushels we got paid for thirty-six bushels only. Another manager puts up a notice that all cars that break down before they are weighed—that is, all coal falling off cars after leaving the miner and before being weighed outside—shall be docked five bushels, the miner losing five bushels besides the coal that falls off the car. This caused a strike. Now, when acts like the above are attempted to be forced on miners, I think they are justified in striking. They have no other redress.

In December, 1875, a committee of miners were invited by the officers of the company to meet them at the office, to receive a proposition the company desired to make. The company officers informed the committee that the mines could not run through the coming winter unless a reduction was made in the price of mining. The miners' committee considered the matter, and agreed to accept a ten per cent. reduction from January 1 to April 1, 1876, the company accepting this offer. On the 5th of February the miners' committee again met the officers of the company by invitation, and were asked to accept another ten per cent. reduction till the first of April, when the given per cent. would be given back, and in view of the circumstances this reduction was also agreed to. But when the first of April came, instead of getting the twenty per cent. back, as the agreement called for, only five and one-half per cent. was given. There has been no strike, but is this fair treatment? Was it not abundant cause for striking? The good feeling which heretofore existed among the miners is destroyed, and when the opportunity comes there will be a day of retaliation.

I know that miners many times get up strikes without cause. I have no excuse for them, but I protest against the blame in all cases being wholly attached to miners.

Very truly,

DAVID THORPE, Miner.

LIST OF SERIOUS ACCIDENTS.

The following is a list of the serious accidents reported to date:

January 10. Anthony Allen, Hardscrabble Mine, Coshocton: hurt on the back by a fall of roof.

January 4. John Bushby, Silver Creek: fall of roof.

January 11. George Williams, Church Hill Slope: caught between cars.

January 18. Thomas Conners, Helens' Mine, Bellair: fall of roof; back and leg broken.

January 22. John Helt, Wadsworth Slope: premature blast.

January 24. Isaac Morguadge, Macksburg Mine: fall of roof; arm broken and otherwise hurt.

January 30. David Hughs, Kyle Shaft: fall of slate; badly hurt in back.

February 1. John Nelson and Nicholas Nelson, Diamond Mine, Wadsworth: hurt in face and arms by a premature blast.

February 3. Charles Simpson, Gravel Shaft: fell down the pit, 110 feet deep.

February 10. Alexander Collier, Silver Creek: fall of coal.

March 3. Charles Nixon, Kyle Shaft: fall of roof; head and face badly hurt.

March 7. Daniel Robertson, Everick's Shaft: crushed between cars.

March 7. Daniel Wise, Boreland's Shaft: cage came down on him.

March 14. Louis Polombo, Sodom Slope: crushed between cars; thigh broken.

March 19. Richard Rowland, Sodom Slope: fall of roof; badly bruised in body.

March 22. Lewis Crosby, Section 19, Nelsonville: fell between cars; four ribs broken.

March 24. John Kinsey, Kyle Shaft: cage fell on him; back badly hurt.

March 24. Charles Smith, Longstreth Mine: run over by loaded car; badly bruised.

March 24. James and German Wallop were badly hurt by a fall of roof, Niles Shaft.

March 28. William Davis, Diamond Slope: premature blast.

March 29. James Miller, Massillon: run over by car on slope; leg broken.

March 31. James Boskill, Globe Slope: fall of roof; thigh broken.

April 5. C. Bramer, Burnett Slope: fall of roof; back and leg broken.

April 8. Wesley Davis, Salina Shaft; drill fell down shaft; arm broken.

April 8. Alex. Powell, Salina Shaft: face and head bruised.

April 9. Joseph Thomas, Church Hill Slope: hand smashed; fall of coal.

April 9. George Miller, Church Hill Slope: fall of slate; head smashed.

April 19. George Brooks, Wood's Mine; fall of slate; badly hurt on body.

April 20. George Leavering, Laurel Hill Mine: fall of coal; hurt in body and limbs.

May 3. Chas. Call, Plummer Hill: fall of coal; hurt on body.

May 6. Adam Lafferty, Plummer Hill: fall of coal; badly hurt on body.

May 18. Morgan Williams, McKinnie's Slope: fire-damp explosion; face and arms burned.

May 27. Bohemian, Foster's Shaft: explosion of fire-damp; burned on body.

June 12. Morgan Jenkins, Shield's Mine, Shawnee: premature blast; cut in head.

June 13. James Means, East Palestine: run over by cars outside; leg cut off.

June 14. Alfred Day, New York Mine: fall of slate; head and breast hurt.

June 20. Richard Rose, Cleveland Shaft: caught between cars; leg broken.

June 25. W. Griffith, Shawnee Valley: fall of coal; leg broken.

June 27. John Fisher, Middleport: fall of coal; badly hurt in body.

June 28. Wm. McMillan, Brookfield Slope: eye lost by wedge splinter.

June 29. George Stansfield, Brookfield Tunnel: fall of roof; back hurt.

June 30. Thomas Thomas, Brookfield Tunnel: fall of roof; body hurt.

July 6. Peter Herald, Straitsville Mine: fall of roof; body bruised and hand smashed.

July 10. Jeremiah Crawley, Salineville: fall of coal; arm broken.

July 16. Harry Carney, Straitsville Mine: fall of slate; ribs broken.

July 26. Richard Jenkings, Niles Shaft: hand smashed between cars.

August 2. Chas. Glee, Wm. Phillips, Enoch Harris, Chas. Van Wicke, George Bowditch, and several others were hurt by the cars running away on the McKinnie Slope.

August 2. George Baker, Austintown: cars run away on slope.

August 7. Peter Keefer, Montana Mine: fall of roof; leg cut off.

August 16. John Crothers, Central Mine: run over by cars; leg broken.

August 23. Thos. Leyshew, Troy Mine: run over by cars; arm broken.

August 25. Frank McInstosh, Pennel Slope: fell off trestle, outside.

September 4. Andrew Landalls, Burnett Slope: fall of rock; leg broken and body bruised.

September 10. Isaac Morris, Church Hill Slope: fall of roof; badly hurt in body.
September 10. Morgan Williams, Church Hill Slope: leg broken in two places.
September 18. Wm. Dalton, Longstreth's Mine; fall of coal; thigh broken.
September 26. Frank Brown, Central Mine: fall of slate; leg broken and hurt on head.
September 26. Howard Williams, Mineral Ridge: fall of rock; badly bruised.
September 27. D. R. Williams, Mineral Ridge: fall of rock; badly bruised.
September 27. Chas. Carrol, Straitsville Mine: fall of slate; leg broken.
October 3. Isaac Evans, Aberdave Shaft: fall of slate; foot badly hurt.
October 10. John Thomas, Coalburg: fall of slate; leg broken.
October 10. John Saunders, Straitsville Mine: fall of slate; very badly hurt.
Octboer 14. Jokh F. Williams, Coalburgh: fall of coal; hurt on head.
October 14. Nickol Stewart, Coalburgh: fell under cars; leg broken.
March 30. Henry Williams, Hayden's Mine: leg broken; fall of coal.
September 30. Isaac Terrel, Weegee: fall of roof.

LIST OF FATAL ACCIDENTS.

The following is a list of fatal accidents, together with the causes of same:

January 7. Theodore Parkes, Bridgeport Mines: fall of roof.
January 22. Geo. Zollern, Wadsworth Slope: suffocated by explosion of powder.
February 16. Cornelius Kyle, Kyle's Shaft: caught by cage in bottom of shaft.
March 16. George Proctor, Salem: fall of roof.
April 12. Henry Lowry, Floodwood: fall of roof.
May 11. Albert Biggory, Plummer Hill: fell of chutes outside.
May 14. Cassius Ewing, Syracuse Slope: fall of roof; lived some weeks.
June 14. Josiah Johnson, Longstreth's Mine: crushed between cars.
June 14. Christian Smith, Pencock Mine, Pomeroy: fall of roof.
September 29. Wm. Martin, Central Mine: premature blast.
October 3. John Fisher, Pomeroy: fall of slate.
November 10. Peter Favor, Osburn Shaft: fall of coal.
Nover 10. Wm. Norton, Laurel Hill: crushed between roof and cars.

The class of accidents, both serious and fatal, resulting from falls of roof and coal in the working places of the miners, exceed in number those which result from all other causes combined. And this is true not of Ohio mines alone, but of every mining district of the United States. Even in the mines of Great Britain they form 42 per cent. of all accidents, and nearly four times more than the accidents resulting from explosions. Accidents caused by falls of roof and coal are mainly under the control of the working miners themselves, and their number can only be lessened by increased care and increased intelligence on the part of the miners. The mining law contains a provision subjecting any miner, to fine and imprisonment who shall refuse or neglect to obey any order given by the mine superintendent in relation to the security of that part of the mine under said miner's immediate charge or control;

but accidents resulting from such refusal are little under the control of the manager, who can not be more than a few minutes each day in the miner's working place, while the dangers of accident is ever recurring.

The reports of the British inspectors of mines for the year 1875 show that 133,306,485 tons of coal, 1,932,294 tons of fire-clay, 12,018,504 tons of iron-stone, and 442,940 tons of shale were mined during the year from the mines classed under the coal miner's regulation act. These figures show an increase over 1874 of 6,716,337 tons of coal, 325,408 tons of iron-stone, and 80,193 tons of shale, but a decrease of 135,497 tons of fire-clay.

There were 1,244 deaths in the mines, coming under the coal miner's regulation act, being an increase in the number of lives lost of 188 over 1874. There was one death by accident for every 430 persons employed in and about the mines, and for every 118,730 tons mined. In 1874 there was one life lost for every 510 persons employed, and for every 133,251 tons raised. In the aggregate, during 1875, 535,845 persons were employed in and about the mines, of whom 427,017 were employed below ground, and 108,282, of whom 6,504 were females, were employed above ground. The number of persons killed in 1875, by explosions of fire-damp, were 288, being an increase over 1874 of 122. The Edmund's Mine explosion killed 143 in one day. The deaths by explosion form a very small per cent. of the fatality of British mines, as the above figures show.

"The reports of the mine inspectors (says the London Mining Journal), consisting chiefly of statistics, can not have many features of attraction for the public generally, but they are nevertheless exceedingly valuable to all engaged in mining operations, inasmuch as they afford conclusive data as to whether the progress which is supposed to be making in mining engineering and mechanical science bears practical fruit in saving of life and lessening the number of accidents in the working of collieries. These reports, also, often contain valuable suggestions from the inspectors, which can not be too deeply impressed upon all who have the management of mines, and which, if adhered to, would undoubtedly tend to lessen accidents and the diminution of the loss of life in the winning of coal. Unfortunately, however, the reports for the past year show that many suggestions and recommendations are disregarded, resulting in serious loss of life, and prove the necessity of some legislative enactment which would make compulsory those safeguards which have been proved efficacious, but which are sadly neglected in some districts. Mr. Thomas Wynne, the inspector for North Staffordshire, in reference to fatal explosions which took place in his district during the past year, says: "I have, year after year, pointed out 'the farce' of using locked safety-lamps where the most dangerous of all lights (blasting) is allowed;" and Mr. Wynne very naturally asks "whether it is advisable to allow these dire calamities to take place, destroying hundreds of valuable lives, which, in the opinion of many persons, are preventable by the simple prohibition of the use of explosives in fiery mines." These words of caution and recommendation on the part of the inspector apply, of course, only to "fiery mines," and we would urge upon the managers of such collieries, that notwithstanding "blasting" is not yet prohibited by parliamentary enactment, they would act wisely and discreetly by resorting to such dangerous practice only in the most exceptional cases, for one fatal accident would far more than outweigh any advantage which accrues from blasting in ordinary mine operations. Powder should never be resorted to except in cases of the direst necessity, and then more than ordinary precaution should be taken to prevent fatal consequences.

"The total quantity of coal raised during the past year was 133,306,485 tons; fire-clay, 1,932,294 tons; iron-stone, 12,018,594 tons; and of shale, 442,940 tons. There were 535,845 persons employed in the various mines—427,017 below ground, and 108,282 (of whom 6,504 were females) above ground. This was a decrease, as compared with the previous year, of 2,589 males and 395 females. We hope the time will shortly come when the employment of females will be prohibited in connection with mines, for such employment is a degradation, and often attended with consequences which all must deplore. The total deaths during the past year amounted to 1,244, having occurred by 927 fatal accidents, being one fatal accident amongst every 578 persons engaged in and about the mines, and one death by accident amongst every 430 persons employed; in other words, no less than 159,331 tons of minerals were raised for each fatal accident, and 118,730 tons for each death by accident.

"It will, doubtless, be remembered that in the discussion which recently took place in the House of Commons in reference to the Employers' Liability Bill, introduced by Mr. Macdonald, that gentleman averred that every accident in a mine "was a crime," and wished to make the proprietors of such pit pecuniarily responsible for compensation to the friends of the deceased. We pointed out at the time the folly and injustice of such assertion, and the reports of the various inspectors for the past year corroborate the view we entertain—that there are some accidents which no human foresight or scientific ingenuity can altogether prevent. But, on the other hand, the statistics presented in the inspectors' reports point out a very large number of fatal accidents of clearly a preventable character, but of a nature which it would be obviously unjust to charge upon the proprietor or manager of the mine, when they have provided every appliance for safety, and the accidents are clearly traceable either to the carelessness or thoughtlessness of the collier. Our remarks apply more especially to the startlingly large number of fatal accidents from "falls of roof," showing a reckless disregard of careful "propping" which too often accompanies the desire for rapid cutting, and which only the care and caution of the working collier can prevent. In many instances the falls of roof far outnumber the deaths from explosions, and, indeed, in some districts form more than one-half of the total number of deaths from every cause. For instance, in the South Wales district (Mr. Thomas E. Wales) the loss of life by falls of coal and stone were no less than 46, as against 20 by explosions, and 127 from all causes. In the Eastern district of Scotland (Mr. Ralph Moore) the deaths resulting from falls of roof and sides, and in shafts, were 43, out of a total loss of 64 deaths, two only having been due to explosions. In the same district there were no less than 154 persons injured by falls of roof and shafts, against 48 by explosions, and a total number of injuries of 315. In the Western district of Scotland "falls" occasioned 38 deaths of a total from all causes of 58. In the Newcastle district "falls" proved fatal to 24 persons, out of a total of 62 deaths underground, whilst in the Yorkshire and Lincolnshire district "falls" proved fatal in 73 cases, explosions proving exceptionally large during the past year, six explosions causing the death of no less than 162 persons.

"As we have before stated, for each fatal accident 159,331 tons of mineral were raised, whilst every 118,730 tons cost us a life during the past year. We raised 6,986,431 tons more than in the preceding year, but we lost 188 more lives, so that the present returns are scarcely so favorable in regard to fatal accidents as last year. To bring to bank, however, out of the many and varied dangers of pit-life, no less than 118,730 tons of minerals is a praiseworthy indication of our mining and engineering skill and science, which we believe is not proportionately equaled in any other country in the world; whilst, if the number of fatal "falls" were reduced to any thing like proper proportions, the results would be such that all connected with our mines might be legitimately proud. The prohibitory use of blasting in all fiery veins, and the greater precaution in propping both in roofs and sides of shafts, appear the practical lessons which should be drawn from the inspectors' reports for the past year; and as they are easy and feasible of adoption, we feel sure that all who are engaged in the dangerous avocation of underground life will feel it both their pleasure and their duty to carry them out to the very best of their ability."

The following figures show the mortality from accidents under different headings for the year 1875:

Name of District.	Name of Inspector.	Life lost per men employed.	Life lost per tons wrought.
Durham	Mr. Bell	771 (2)	261,796 (1)
Yorkshire	Mr. Wardell	234 (12)	60,962 (12)
North and East Lancashire	Mr. Dickinson	440 (6)	119,581 (7)
Newcastle	Mr. Willis	686 (3)	196,812 (3)
Midland	Mr. Evans	783 (1)	188,699 (4)
St. Helens, Wigan, etc	Mr. Hall	349 (10)	88,840 (8)
North Stafford	Mr. Wynne	286 (11)	78,494 (10)
South Stafford	Mr. Baker	424 (7)	129,994 (6)
South Western	Mr. Brough	397 (9)	74,852 (11)
South Wales	Mr. Wales	404 (8)	80,903 (9)
East Scotland	Mr. Moore	645 (4)	198,614 (2)
West Scotland	Mr. Alexander	523 (5)	156,330 (5)

ACCIDENTS IN PRUSSIAN AND ENGLISH MINES.

Since 1869, all accidents in mines involving loss of life in Prussia have to be entered by the mining authorities on special forms, which are sent in at the end of the year to the Statistical Office at Berlin. Here the materials are worked into a summary, containing the respective occupations of those killed, classing the accidents according to their severity, and grouping them in accordance with their causes. The summaries for 1874 and 1875 show that in the former year 589, and in the latter year 578, persons lost their lives in Prussian mines, of which 572 and 573, respectively, were overtaken by death while actually at work. Of the latter number, the following were killed in—

	1874.	1875.
Coal mines	484	438
Brown-coal mines	36	42
Ore mines	36	82
Other mineral-producing occupations	16	11

To judge correctly the importance of those figures, it is necessary to know the number of persons employed in each branch, which up to the present time are known only for the year 1874. In that year the average number employed in coal mines was 161,502; in brown-coal mines, 18,645; in ore mines, 58,822; and in other mineral-producing branches, 872 persons. Thus the number of killed in 1874 per thousand was 2.99 in coal mines, 1.93 in brown-coal mines, 0.61 in ore mines, and 1.83 in other mineral-producing occupations.

It is not uninteresting to compare the figures of the loss of life in Prussian mines with that in English mines, on which the reports of the inspectors of mines give yearly full information. Unfortunately the comparison between the English and Prussian reports is only of a very restricted nature. In the English reports the grouping observed is not the same as in the Prussian statistics, coal, iron-stone, clay, and coal-slate mines, in accordance with the Coal Mines Regulation Act, being combined in one group, the other group—of still greater importance, and comprising, besides iron, lead and tin mining—being subject to the Metalliferous Mines Regulation Act. In the 4,501 mines affected by the first named act, 1,056 persons lost their lives in 1874, and 1,244 in 1875, while in the mines regulated by the Metalliferous Mines Act 103 persons were killed in 1874, and 119 in 1875. The number of persons employed in coal, iron-stone, clay, and coal-slate mines was 538,829 in 1874, and 535,845 in 1875, and in the remaining mines 56,361 in 1874, and 58,073 in 1875. Of 1,000 persons employed in the first group of mining operations, therefore, 1.96 were killed in 1874, and 2.32 in 1875, while in the second group 1.83 in 1874, and 2.05 in 1875, lost their lives.

In the English mines, under the operation of the Coal Mines Regulation Act, 140,713,832 tons were raised in 1874, and 147,700,313 tons in 1875, so that there was one person killed in 1874 to every 133,251 tons (2,665,020 Prussian cwt.) of coals raised, and in 1875 to every 118,730 tons (2,374,600 cwt.). In Prussia, however, one person was killed for every 1,319,780 cwt. raised, of the value of £34,856, from coal mines; 4,842,583 cwt., of the value of £43,705, from brown-coal mines; 1.952,086 cwt., of the value of £81,572, from ore mines; and 285,766 cwt., of the value of £6,245, in other mineral-producing pursuits.

ACCIDENTS IN PENNSYLVANIA.

The reports of the Pennsylvania Mine Inspectors for the year 1875 show the following list of accidents:

POTTSVILLE DISTRICT CASUALTIES AND THEIR CHARACTER.

Twenty-eight fatal accidents occurred in and about the collieries of this district during the year; but since the 22d of September last the district has been increased by the addition to it of New Boston Basin collieries, and all collieries now west of the west branch of the Schuylkill River, and south of Broad Mountain, in Schuylkill county, except Brookside colliery. It extends from Carbon county to Dauphin county line, and is thirty-eight miles in extent.

CHARACTER OF FATALITIES.

Lives lost by falls of coal	5
" falls of rock and slate	3
" explosion of fire-damp	7
" explosion of powder	1
" explosion of a blast	1
" being crushed by wagons	1
" breaking of slope chain	3
" falling into slopes and shafts, etc.	2
" falling of cages	2
" being crushed in machinery	1
" being crushed by trestleing	1
" hemorrhage	1
	28

The above twenty-eight persons left seventeen widows and sixty-two orphans. There were also eighty-eight non-fatal accidents.

SHENANDOAH DISTRICT CASUALTIES AND THEIR CHARACTER.

Twenty-six fatal accidents occurred in this district during the year; but since the 22d of September the district was divided, and all the collieries situated west of the eastern limit of Girardsville, and north of Broad Mountain, in Schuylkill county, and all the collieries in Columbia county, were cut off and the same added to Shamokin district, which accounts for the increase in fatal casualties in the Shamokin district this year.

CHARACTER OF FATALITIES.

Lives lost by falls of coal	8
" falls of rocks and slate	3
" breaking of ropes and chains	1
" falling into slopes and shafts	1
" explosions of boilers	3
" being crushed in the rollers	3
" being crushed in machinery	2
" falling into open breasts	2
" explosion of fire-damp	1
" being crushed by wagons	1
	26

The above twenty-six persons left eleven widows and forty-nine orphans. One hundred and fourteen persons were maimed and injured.

SHAMOKIN DISTRICT CASUALTIES AND THEIR FATAL CHARACTER.

Thirty-eight persons came to their death in this district during the year; but since the 22d of September last the district has been re-formed. At present it comprises all the collieries in Schuylkill county north of the Broad Mountain and west of the eastern boundary line of the borough of Girardsville, together with all the collieries in Columbia, Northumberland, and Dauphin counties, and the Brookfield colliery in West Schuylkill.

CHARACTER OF FATALITIES.

Lives lost by	falls of coal	14
"	falls of rock and slate	5
"	explosions of powder	5
"	explosions of blasts	2
"	being crushed between wagons	6
"	breaking of chains	2
"	being crushed by machinery	2
"	falling into rollers	1
"	explosion of fire-damp	1

ORIGIN OF THE COAL STRATA.

Every intelligent person now believes that coal has been formed from decomposed vegetable matter—the leaves and stems of ancient plants and trees, which grew and fell and decomposed and became mineralized on the ground where the coal is now found, and that the associated strata have been derived from the sediments of the water which flowed over the carbonaceous accumulation during the subsidence of the land.

During the coal formation period in the physical history of the earth vast marshes or swampy plains skirted the ocean or formed low islands near the shore. This land surface was composed of a soft and light soil, from a few inches to several feet in depth, upon which there arose a profuse and luxuriant vegetation, consisting of numerous beautiful and various plants, varying in size from small mosses to stately trees. Year after year the forest dropped its leaves and fruit, and in time died itself, to be succeeded by new growths. After many slowly moving centuries had passed, a mingled mass of vegetable matter was formed, like the pulpy mass of a modern peat bog. At length, through the agency of subterranean forces, the land slowly and gradually sank, and the waters of the ocean flowed in over the carbonaceous material, bringing sand and mud and other sedimentary materials, which settled on the coal marsh. As the sinking process continued, the ocean current brought in more detritus, covering up the older accumulations. The buried peat bog became compressed by the accumulated weight of the ocean sand and mud, and the original plants and peaty tissue finally became hard and compact mineralized coal. The mud and sand also solidified, forming sandstones, shales, etc., according to the nature of the sedimentary materials.

The subsidence period was arrested in time, and was followed by a long period of rest, during which time the ocean not only was filled up, and a new land surface formed, but new growths and decays of vegetation occurred, as in the formation of the first seam of coal. This was followed by another downward movement of the land and another burial of the coal vegetation by the detritus of the ocean currents. The set of processes thus described were repeated in the formation of every seam of coal and its associated strata. Late investigations made by eminent geologists have suggested that it would require sixty generations of trees and eighteen centuries to form a foot in thickness of coal.

The coal strata are marked with the remains of both animal and vegetable life. The original soil in which the coal plants grew—the present fire-clay floor of the mine—contains numerous rootlets and stumps of trees, while the immediate cover of the coal, the first deposition of sedimentary material which flowed over the coal marsh, is often marked with beautiful impressions of trees stretched full length as they fell. Pieces of bark, branches, leaves, and ferns also cross each other in beautiful profusion.

There are in the Coal Measures of Ohio sixteen different seams of coal which exceed two feet in thickness. There are several other seams, but they are very thin, not exceeding two to six inches in height, and they are often of quite limited area. Thirteen or fourteen of the series are of workable thickness in many places of the coal field, but with the exception of No. 6, all the lower workable coals are subject to wants or faults, or become so reduced in height as to be of little or no commercial value over large areas where they are due. Even No. 6, which, in many places in Perry, Jefferson, and Tuscarawas counties, rises to the magnificent height of eight and ten feet, dwarfs to two or two and one-half feet, then down to a mere trace, and sometimes disappears altogether. No. 8, the Pittsburgh seam, is remarkable alike for its continuity wherever it is due, and for its presence in workable height.

Though there are numerous wants in the different coal beds of the State, there is a general continuity of the seams from outcrop to outcrop. The coals of the Mahoning valley and Massillon regions have their representatives in the Jackson and Lawrence districts. The wants or interruptions are the result of water spaces exsting in the old coal plain at the time of the deposition of the coal vegetation, and also of denuding forces and the rolling or hilly character of the coal marsh. Where wants are met in any of the seams having level floors, the coal has been eroded by currents of water in rapid motion passing over the loosely matted peaty material, and cutting or washing channels through part or the whole thickness of the peat bog during the first stages of the subsidence of the coal. Sandstones, fire-clays, or shales, usually the two former, are found usurping the place of the eroded coal where wants are found in any of the seams due to erosive agencies or to original water spaces. The floor of the coal beds is almost invariably wavy and rolling, the high arches or hills containing barren ground. The coal is seen to become gradually thinner in ascending these hills, and finally to disappear altogether. This wavy character of the coal floors is more marked in the lower than in theupper coals of the series, and is most marked of all in the lowest seam, or Coal No. 1.

. The strata associated with the different beds of coal are composed of sheets of shales, sandstones, limestones, iron ores, and fire-clays in alternating layers. None of these sheets, except the fire-clays forming the floor of the coal beds, are persistent like the coals, but appear and disappear at frequent intervals. The shales are replaced by sandstones, the sandstones by shales, the limestones change to pure or calcareous shale or sandstone, and the iron ores also become changed to other rocks. The first deposition of sedimentary material which formed over the coal after the subsidence of the coal marsh was very generally mud (now shale), though sandstone, impregnated with the remains of the coal flora, showing that this was the first formation, is sometimes found forming the coal roof. Frequently a sandstone roof is met, but shale was the first deposition, and was subsequently removed. None of the sheets forming the coal strata are very thick. Masses of material, either sandstone or shale, several hundred feet in thickness, are met, but on close examination they are found to change in color and character, the alternating shales being black, blue, gray, light, etc., and the sandstones being light, red, buff, gray, etc.

COAL NO. 1, IN MAHONING VALLEY.

The various beds of coal, as I have said, often occupy very uneven floors, the changes of level in distances of a few hundred feet being frequently fifty and sixty feet. The more rapid changes of level occur in the lower coal of the series, No. 1 of the geological nomenclature. In the Mahoning Valley this seam occupies a series of long, serpentine, and, generally, narrow swamps or troughs. Frequently two or more of these troughs run alongside of each other in nearly parallel lines, the coal stretching from one basin to another, over an anticlinal arch, without a want or break in its continuity. But generally the basins are separated from each other by large intervals of barren ground. The line of direction of these swamps is usually south-west, though their course is very zigzag. The coal is always thickest in the hollows or low places of the mine, and thinnest on the hills and ridges. In the Massillon and Jackson regions this seam of coal, though marked by the same rapid changes of level as in the Mahoning Valley, stretches out in a series of hollows and ridges without break (though with a marked loss of height on the hills), and occupies larger areas in consequence, but there is also large breaks of barren ground where the coal is due.

The troughs in which the coal of the Mahoning Valley rests have been scooped out of an originally level plain by erosive agencies, and the ridges which separate the adjoining swamps upon which the high and thin coal reposes are not the tops of the old plain, but knolls pared down to a less depth than the swamps below. The top of the old plain is one hundred to one hundred and twenty feet above the bottom of the swamps. This plain is not level, but is scored by erosion, forming wavy strata, after the manner of the strata in the mines, though the hollows are too shallow to hold the coal. Hence vast areas of barren ground exist where the coal is due, that is, within the coal-producing area, the shales and sandstones of the Coal Measures resting on the Conglomerate or Waverly sandstone. There is not one acre in fifteen which holds coal where coal is due, and much of the coal found on the hill-sides, and even in the swamps, is too thin for commercial purposes.

The lower coal in Jackson county rests in a basin scooped out of the Conglomorate rock, the Conglomorate being there thirty to fifty feet thick. In the Mahoning Valley the Conglomerate is generally quite thin, from one to twenty feet, and is often wanting, and the coal troughs are cut down through it, or its horizon, far into the upper surface of the Waverly sandstone. Patches of the Conglomerate frequently form the roof of the coal in the Mahoning Valley, near the margin of the coal field, whence it was supposed by the Pennsylvania geologists that this was a sub-carboniferous coal, but its true place is in the Coal Measures, of which it forms the base or lower bed.

The most northerly points in the Mahoning Valley where the lower or block coal has been found are in Hartford and Fowler townships, in Trumbull county. The basins in which the coal rests are there very shallow and narrow, hence the coal is thin and of limited area. These points are, without doubt, the extreme margins of the coal field—the heads of the troughs of the old coal marsh. Coming southward into Brookfield and Vienna, the swamps are deep and broad, and the coal is of good minable height and of extended existence. East of Brookfield we pass into Pennsylvania, where, in Hickory and Lackawannock townships, the block coal is found abundantly, but northward, as in Ohio, it appears to thin out on the heads of the swamps. The coal rises to the north and east, more east than north, gets gradually thinner in the swamps in that direction, and is covered with a stratum of fire-clay. In Pamatumyng township, and in the vicinity of Greenfield, northward of Hickory, a long tongue or trough extends, apparently the extension of the Curtis Hill swamp, holding coal of good workable height. At other points east of Pamatumyng there is coal material, but the shales or sandstone of the Coal Measures are found resting on the Waverly or Conglomerate.

Both in Pennsylvania and Ohio the general line of direction of the swamps is south-west, but they frequently change and point to every degree of the compass. Some of the troughs are not more than two hundred feet wide, the coal rising and thinning out on steep hills on both sides; others flatten out into broad plains; again, there will be alternating hill and swamp, forming synclinal and anteclinal curves or arches, without break in the continuity of the coal, though with an invariable loss of height on the ridges.

Passing due westward from Curtis Hill, opposite Sharon, there is no coal in Ohio till we reach Vienna, thirteen miles distant. The coal material is found overlying the Conglomerate and Waverly, but there are no swamps deep enough to hold the coal. South of this line, only four miles, the swamps are broad and deep, and there are a series of mines extending from Applegate's Slope to Sodom Slope, a distance of seven miles, and the intervals of barren ground are few and narrow, the coal boldly rising and falling over hollow and hill. There is little coal west of Sodom Slope, certainly none west of Kline's Corners. From Sodom Slope the strata gradually rise westward, undulating, however, into shallow basins without coal, till at Loy's Corners, two and a half miles west of the slope, the Waverly sandstone underlies the "Drift," within a few feet of the top of the ground. Beginning at Vienna, and passing south to Church Hill, there is no coal north of this line, the swamps holding the coal, which pursue a south-west course, having no existence. The line of barren ground follows the general line of the swamps, the Waverly strata rising to the north-west and coming to the surface a mile or two west of the most westerly swamp holding the coal. The Waverly sandstone, which, along this line, comes to the surface, is one hundred and twenty feet higher than the swamp coal in the mines.

The mines in the townships of Vienna, Liberty, and Youngstown, and in Brookfield and Hubbard townships, have been so fully developed that the length and width of the various basins might be mapped out. In the low places or swamps, where there is thin coal, or where there is no coal at all, but sandstone or fire-clay usurping the place of the seam, an approximate estimate of the area of unproductive ground would not be difficult. The work could not be done very accurately, owing to the winding course of the swamps, and to their liability to spread out or narrow down.

While the general course of these coal-basin swamps is south-west, there are many branch swamps, extending from east to west, which connect the coal of adjoining basins. For example, the coal of the Applegate and Love banks is connected, although the coal of each forms independent basins, and the Love bank will doubtless connect on the west with one of the mines of the Mahoning Coal Company, and the Mahoning coal mines with Sodom Slope, or with some adjoining coal. The coal may not be present in workable height all the way, but the swamp will doubtless be there.

There is not always a continuity of workable coal, from mine to mine, in the line of direction of the main swamps, that is, between mines opened south-west of each other. The swamp, or coal floor, never gives out, but the coal, as I have stated, frequently becomes reduced in height or disappears altogether, and prevents the junction of the two mines. This fault in the coal is generally called a "horseback," and is due to the eroding of the coal by water currents carrying sand or clay, which scooped out the peatty material which subsequently formed the coal, in the same manner as the coal is cut out on the hill-sides of the mine. If these horsebacks are only a few yards in thickness they are cut through by the miner, but if they extend several hundred yards the mine is abandoned on this line, and a new opening, a shaft or slope, sunk on the other side of the fault. The coal is not always wholly cut out by these horsebacks, but is pared down to a foot or fifteen inches. The cost of driving an entry several hundred yards in thin coal is greater than the cost of making a new opening on the other side of the horseback.

When the coal rises on hill-sides out of the swamps, and gradually loses height, it seldom thins out like the point of a wedge, but is suddenly cut away while the seam may be yet eighteen inches or two feet, or even three feet, thick, according to the varying vertical distance from the bottom of the trough. The first indication which the miner sees of losing the seam suddenly is the appearance of a white roof of sandstone or fireclay, or a mingled strata of both. A few yards in advance, particularly if the hill on which the coal is rising be a steep one, this foreign roof comes down on the coal floor, and the coal is gone forever. The waters which flowed over the coal marsh, during the subsidence of the land, appear to have cut a channel through the loosely matted coal vegetation, washing it out and carrying it away, while the sediments of the water, clay or sand, or a mingling of both, settled down in the place of the eroded vegetable material. If the swamp be a single one, the coal is found cut away on both sides, though on one side the wash-fault may be ten or even twenty feet higher than on the other. If there be a hill between two adjoining swamps the coal will rise on it and dip over it into the adjoining trough without break in the continuity of the bed, and the fire-clay or sandstone roof will not appear. Some of these hills between two basins are fifty and sixty feet high, and on top the coal will have thinned down to ten inches or a foot, but it bravely holds on and plunges downward into the other swamp, increasing in height, yard by yard, until the usual thickness of seam is met in the low ground. On the opposite side of the swamp, if there be no other swamp adjoining, the coal, in many cases, will be cut away by the white roof before it has reached twenty or thirty feet of perpendicular height in climbing that hill-side.

The wash-faults which so frequently erode the coal on the hill-sides in this valley are met in several seams of coal higher up in the series, notably in Coal No. 5, where that seam is opened in the Muskingum Valley, and also in the seam first met above the horizon of No. 6.

The hills are not as steep as in the Mahoning Valley, but the same agencies of removal—the cutting away of the seam by water currents and the usurpation of the coal by fire-clay—are met. Such cases will be described in subsequent pages.

There are many beautiful coal flora in the roof shale of the mines opened in the Briar Hill coal of this valley, rivaling any thing that may be seen in a princely conservatory.

COAL NO. 1, AT MINERAL RIDGE.

On the west side of the Mahoning River, near Mineral Ridge, the coal changes in character from a block or long-grained coal to a blasting or short-grained coal, and the seam splits in two, the intercalated material being composed of gray shale and blackband iron ore, unitedly ranging from one to five feet in thickness. The roof of the mines also changes from a shale to a coarse-grained sandstone, often a Conglomerate rock. This rock was the first cover of the coal, as is shown by the impressions of the coal flora which lie stretched in the roof. The change in the character of the coal first appears between the old Weathersfield Slope and the Weathersfield Shaft. A thin wedge of shale appears in the coal, near the middle of the seam, which increases in thickness to the west. There is little blackband in the Weathersfield Shaft, but in the mines at Mineral Ridge this ore is always present. The lower bench of coal loses in height in passing westward, falling from two feet to six inches or less. This bench remains a "block coal" of very superior quality, and the two benches are so unlike that they might well be taken for two seams running together.

The hills in the mines at Mineral Ridge are generally low and seldom cut out the coal, the bed rising and falling over hill and dale without any great inconvenience to the miner; but the gray shale, called "wide-awake" by the miners, and the blackband ore which lies on the "wide-awake," lose height and thin out. The blackband, which ranges from four inches to a foot in thickness, thins out first; then the "wide-awake," which is the thicker of the two, thins out in going higher. As the intercalated strata disappear, the two coal benches unite. On descending the hill on the opposite side, the "wide-awake" and blackband again come in. In the high hills, which rise to forty feet, the coal also thins out, but it generally holds bravely on, until it thins down to a point, and is seldom cut away suddenly by a wash-fault, as in the block coal mines.

The blackband ore is mined in connection with the coal, and calcined at the pit's mouth. There is always more or less coal sticking to the ore, and sometimes thin streaks of coal are interstratified with it, which serve as fuel in roasting the iron-stone. When calcined, forty-five to fifty per cent. of iron is contained in the ore. It is then used in the blast-furnace in connection with the rich ores of Lake Superior, making a very superior brand of iron known in market as "American Scotch." Without the presence of this blackband the mines could not be worked with profit, so inferior in quality and so costly to mine is the Mineral Ridge coal as compared with the Briar Hill variety. For house fuel and for rolling-mill purposes it is best adapted, and is generally put to these uses.

In some of the favored parts of the mines the blackband ore yields a ton of ore to a ton of coal, but one ton of ore to three tons of coal is about the general average. The "wide-awake" shale forms the floor of the mines.

South of Mineral Ridge there is coal in abundance, but it appears to be too thin for mining purposes at present. Still further south, at the Wick & Wells Shaft, in Austintown, the seam has recovered all its lost height, and the Conglomerate and sandstone roof have disappeared. In this mine the seam is still in two benches, the "wide-awake" appearing near the middle of the coal; but east, at Powers's Mine, it is a homogeneous mass, and a good block coal. West of the Wick & Wells Shaft, at Weaver's Corners, the coal is again homogeneous. South of the Wick & Wells Mine the coal has been found in boring, and the two benches are still revealed. The area occupied by the coal in two benches does not appear to be more than two miles wide, reaching from east to west, but its length from north to south is unknown. Only at Mineral Ridge has the blackband ore been met.

The Conglomerate rock forming the roof of the Mineral Ridge Mines is sometimes present at Vienna. In Brookfield, at the Curtis Hill Mine, it is also present; so, also, at the Seceder and Moore Mines, in Liberty township. The Conglomerate under the coal, and the Conglomerate over the coal, are composed of the same materials.

From twenty-four to sixty feet above the block coal there is a second seam—No. 2 of the Geological Survey. It is a very persistent coal, and is generally present where No. 1 is due, except where it has subsequently been removed by denudation. On the high lands or hills which border the swamps in which Coal No. 1 reposes, both seams are generally absent, because the Waverly sandstone and Conglomerate reach up above the horizon of both seams. If the hill be sloping gently, No 2 may overlap No. 1, until it thins out or abuts against the Waverly. If the hill is too high to hold No. 1, but not too high to hold No. 2, this latter coal may have for its floor the Waverly sandstone or Conglomerate, the true floor of No. 1.

Coal No. 2 is seldom more than eighteen inches thick, and is often less than one foot. The varying thickness of strata between the two coals—twenty-four to sixty feet—is often found in the swamps, and is caused by the lower coal dipping in one direction and the upper one going perfectly level or gently rising in the same direction. In Hubbard the distance between these coals in the swamps is about twenty-four feet; at Mineral Ridge, in the swamp of the Morris & Price Shaft, it is sixty feet.

On page 498, Vol. I., Ohio Geological Survey, the wavy character of the floor of Coal No. 1 is shown in comparing the varying depth of twelve drill-holes put down on the mining property of the Brookfield Coal Company, in Trumbull county. Four of the holes in question show changes in level respectively of 14.86 feet, 24.18 feet, 28.38 feet, and 54.80 feet, as compared with the coal found in the first hole drilled.

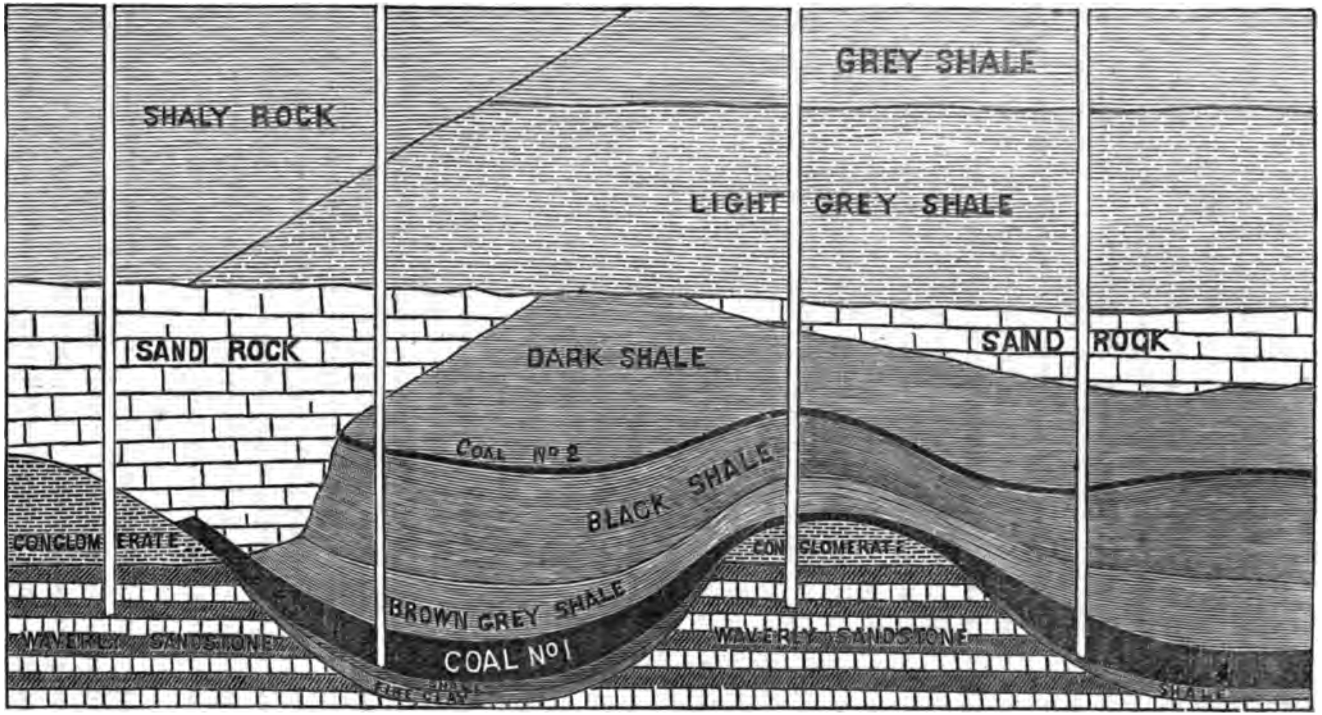
"These great irregularities in the position of the coal in one small coal basin," says Mr. Read, "are more remarkable when the additional fact is considered, that at forty-two and one-half feet above the block coal a thin seam (Coal No. 2) was passed through in drilling the first hole, and that the coal maintained a perfectly horizontal position over the whole area, and was constantly found at an elevation of forty-five and one-half feet above the point adopted as a base, so that in this one basin the distance between these two seams varies from 44.5 to 100.3 feet."

Mr. Read is mistaken in making this statement, having evidently been misinformed by the surveyor who platted the holes from the journal of the coal-drillers. The facts are that Coal No. 2 shows changes of level conformable to Coal No. 1, though these changes are less marked in the upper coal. A moment's reflection as to the manner in which the sediments of the water, now forming sandstone and shales, were deposited during the subsidence of the land, would have convinced the geologist of the fallacy of this assumption of facts. The thin stratum of coal associated with the iron ore in the ore mine of J. W. Leyde, in Hubbard township, is also not "Coal No. 2," as stated in the geological report, but a stratum lying sixty to eighty feet above the horizon of No. 2, probably the representative of No. 3. The same coal and ore are found on the lands of Jesse Hoagland, in Hickory township, Pennsylvania. Coal No. 2 is passed through in the air-shaft of Pierce's mine adjoining, eighty feet below the horizon of Hoagland's drift mine. Coal No. 1 was deposited, as I have stated, only in troughs or basins. When the carbonaceous matter which forms the coal had all accumulated, the center of the peat bog on the bottom of the swamp would be fully fifty feet thick; half way up the hill-side it would be twenty-five feet; while at its edges, or outcrops, not more than one foot would be accumulated. When the subsidence occurred and the sediments of the water settled over the coal marsh, the loosely matted vegetable material became compressed from fifty feet to four feet in the swamp, and from twenty-five to two feet half way up the hill, and from one foot to one inch at the edge. The strata forming over the coal vegetation in the swamp would bend as the coal became more and more compressed by the weight of the accumulating sediment, conforming to the bending of the coal, though in a less degree in ascending order. Hence when Coal No. 2 was deposited there was still an irregular, though a less irregular floor, waving up and down, as in the case of Coal No. 1. And this is what we find in practice, not only in the Brookfield Coal Company's mine, but in every mine in the Mahoning and Shenango valleys. These facts are proved by ocular demonstration in the air-shafts and hoisting-shafts of numerous mines. The hoisting-shaft (or slope) is generally sunk in or near the swamp or low place in the coal, while the air-shaft is generally put down on the highest hills, and the two coals show the conformable character which I have stated. The cut on the following page illustrates the facts, and shows, also, the various strata and their frequent changes from rock to slate, etc.

In the deeper shafts of the valley there are three seams met with above the block coal; the upper two seldom rise to six inches in height, are often present only as a mere brace, and are frequently wanting altogether. They are doubtless the representatives of Coals Nos. 3 and 4, which, south of Mineral Ridge, rise to two and a half and three and a half feet.

The first twelve to sixteen feet of shale forming the cover of the block coal is generally a brown shale, hard and compact, making a firm and safe roof for the miners. The eight or ten inches next the coal is black and somewhat softer than the brown material, and is, particularly in the swamps, often filled with the impressions of fern leaves.

Above the brown shale there is a stratum of black and soft shale, of



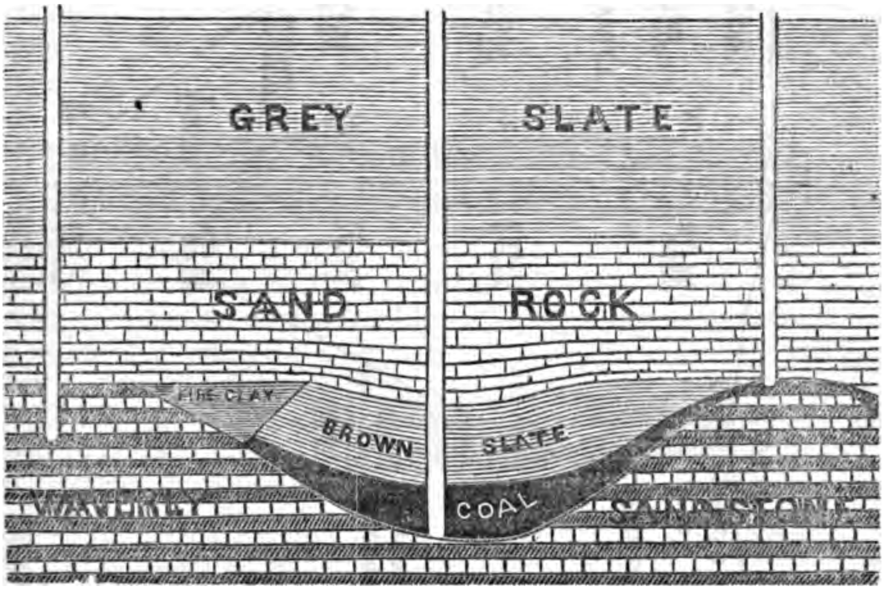
SECTION OF STRATA IN MAHONING VALLEY.

varying thickness, upon which Coal No. 2 rests. Higher up the strata are very irregular, drill-holes seldom passing through material alike in thickness and character. In one hole there is sandstone in a homogeneous mass; in another the sandstone is met in several beds, with shales between them; and in the next there may be nothing but shale from top to bottom.

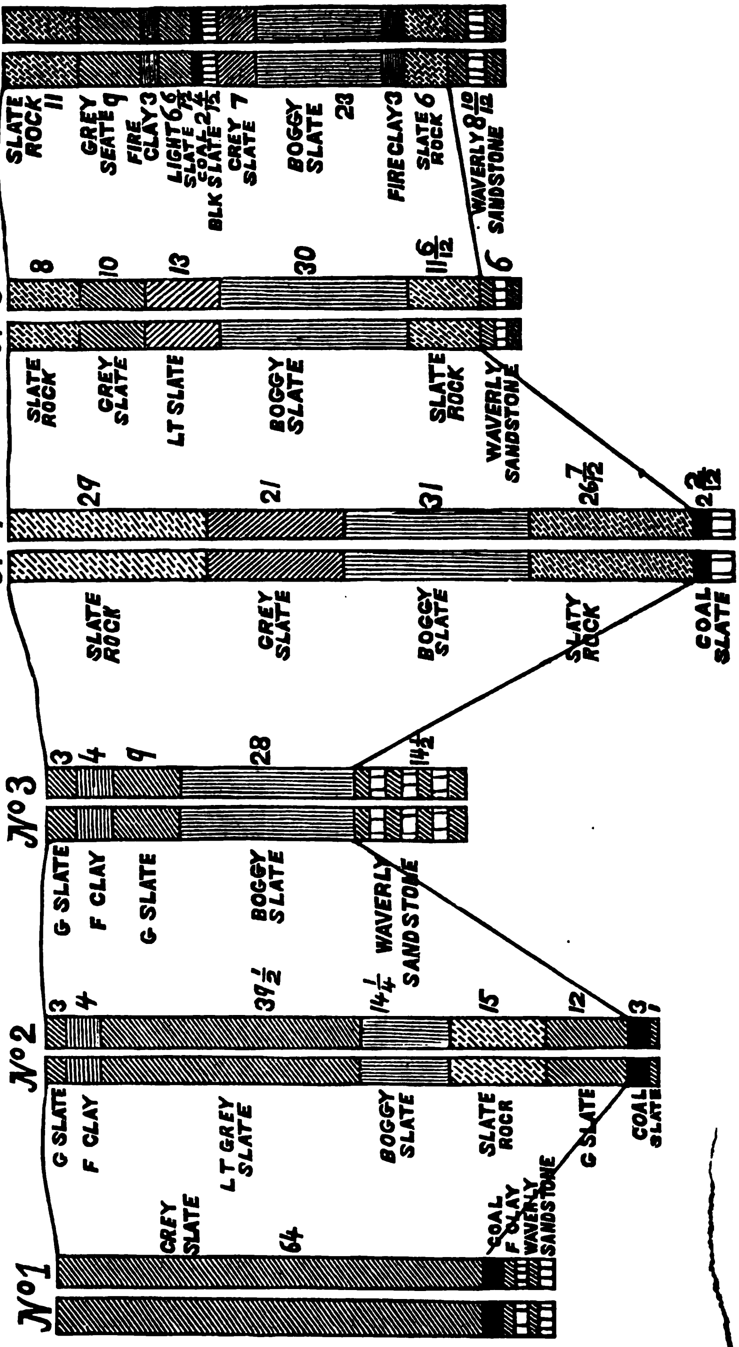
The shales are, however, the prevailing strata, many shafts, one hundred to one hundred and eighty feet deep, having few or no sandstone beds. The geologists, in locating a massive and persistent bed of sandstone above the coal, and separated from it by a few feet of shale, are misinformed as to the facts. A bed of sandstone is sometimes there, but it is, like all the sandstones, of irregular thickness and deposition. When present it generally cuts out Coal No. 2, and sometimes No. 1 also, forming the horsebacks of the mines.

Prof. Rogers, chief of the former Geological Survey of Pennsylvania, located this coal below the sub-conglomerate rock—the foundation-stone of the true Coal Measures—and hence called it a sub-carboniferous coal. Dr. Newberry, chief of the Ohio Geological Survey, has shown that its true place is above, not below, the Conglomerate rock, and that it is a true Coal Measure bed. Prof. Leslie, chief of the present Geological Survey of Pennsylvania, disputes Dr. Newberry's position, and reasserts that it is a sub-carboniferous coal. I have had repeated opportunities, both as a working miner and as mine inspector, to observe the position of this coal in many of the mines in the Shenango Valley of Pennsylvania, and in all of the mines of the Mahoning Valley of Ohio, and find it frequently capped with a Conglomerate rock, and still more frequently, especially in the swamps or troughs of the mines, not only below the horizon of the true Conglomerate, but also below the upper surface of the Waverly sandstone; and *yet it is a true Coal Measure seam.* The upper strata of the Waverly and the true Conglomerate also were deposited before the coal was deposited; the troughs or swamps in which the coal reposes below the horizon of the Conglomerate being, as has been shown, scooped or eroded out of a once comparatively level plain, anterior to the deposition of the coal vegetation. The pebbly sandstone sometimes forming the roof of the coal is not the equivalent of the pebbly sandstone underlying the coal, but a newer deposit of the Carboniferous age. In the Curtis Hill Mine, in Ohio, and in some of the mines in Pennsylvania, a conglomerate floor and a conglomerate roof are seen in the same working-place of the miner.

The accompanying cut shows the coal in the swamp below the upper surface of the Waverly sandstone. The coal ascending the hill on the right rises over the top of the Waverly, and is seen to commence plunging downwards into an adjoining swamp. In the diagram there is no conglomerate present below the coal; but this is not an unusual circumstance. On the left side the coal does not rise more than half way on the hill till it is cut out by a white roof of fire-clay. The immediate cover of the coal in the swamp is a brown shale, a material uniformly forming the roof strata, except where a foreign material of fire-clay or sandstone appears. Three bore-holes are shown in the cut. The left hole, put down outside of the basin, strikes the Waverly—the "bottom rock" of the drillers—high above the coal in the swamp, and after passing into "bottom" a few feet, the hole is abandoned. The middle hole goes down into the thick coal in the swamp, while the right hole taps the thin coal on the top of the arch which divides two swamps. Above the brown slate there is a bed of sandstone. This is not a persistent sandstone, but where present it sometimes comes down on top of the coal, and cuts into the seam, forming a horseback.



The Conglomerate overlying the coal and the sub-conglomerate forming the floor of the coal generally resemble each other in appearance, and are perhaps the same material, though of different ages. Dr. Newberry regards the upper member as the washings of the ancient beach which bordered the coal marsh, and that it was deposited only on the extreme outcrop of the coal area. It is, however, not confined to the mines on the extreme outcrop of the coal area, but is found overlying the coal



The line shows the bottom of Coal Material in each hole.

in Liberty township, at the Seceder and Moore Mines, ten miles south of the coal outcrop. May it not be the washings of the hills over the coal vegetation into the eroded valleys below, in the first stages of the subsidence of the coal marsh?

I have selected six holes from the journal of Solon Bailey, Esq., a gentleman who has followed boring for coal in the Shenango and Mahoning valleys for the last sixteen years. These holes were drilled two years ago in Liberty township, Trumbull county, and are all within twenty-five rods of each other, except the last, which is thirty rods north of No. 5. They were located in nearly the form of the letter N. I have excluded the "drift" in the sections, and made a line showing the difference in the level in striking solid material. These holes were selected at random, and show nothing unusual in the structure of the strata. It will be noticed that the coal material gives out in No. 3, more than forty feet above the horizon of the coal found in No. 2, the last fourteen feet of hole No. 3 being bored in the Waverly sandstone, the "bottom rock" of the drillers; also, that the horizon of the coal in No. 4 is nearly fifty feet below the bottom of the coal strata in No. 3. No. 6 contains a four-inch seam of coal, forty-one feet above the bottom of the coal material, and eighty feet above the horizon of the coal in hole No. 4. This thin seam is not the equivalent of No. 2, but of a thin seam sometimes met fifty to sixty feet above No. 2. No. 2 is not present in any of the drill-holes, and is generally absent in this locality, its place being usurped by shaly rock.

A glance at the drill-holes of Mr. Bailey, and at the preceding cut, will show the difficulty in establishing the relations of Coal No. 1 to the "Conglomerate rock." The Pennsylvania geologists, in stating that the coal is below the Conglomerate, and is therefore a sub-carboniferous seam, may well be excused for falling into error, for, while a true Coal Measure bed, it underlies the horizon of the foundation stone of the coal strata in the swamps of the mine. This peculiarity of the seam also greatly perplexes the land-owner, as well as the geologist, in leasing his land for coal. He can not understand why his lands have been tested fairly, when the coal-drillers say they have gone down below the level of the coal rocks and found no coal, while they acknowledged in the same breath that they did not go down to the coal horizon by twenty to thirty feet.

The dip of the coal is south-west, following the direction of the swamps at the rate of about thirty feet to the mile. The dip is not uniform, and it sometimes reverses itself. In Hickory and Lackawannock townships, in Pennsylvania, the direction of the swamps is generally south-east, and the dip is in that direction.

The floor of the coal is sometimes sandstone, sometimes a black carbonaceous shale, and sometimes light shale. The troughs, after being scooped out of the old plains, were filled up for a few feet with sedementary materials washed from the hills, or deposited by water currents, carried along their bottoms. The higher we ascend the sides of the troughs the less is seen of this material, until the coal, as it thins out on the ridges, is found resting on the bare Waverly sandstone. There is less fire-clay forming the floor of the mines in this region than in any other district of the State. In the bottom of the swamps there is nearly always a black carbonaceous shale present; below that often a stratum of sandstone, in which *Calamites* and *Stigmaria* abound. Indeed, it may be said that this is a coal seam in which there is no underlying clay; but this is not the only case of the kind encountered in coal mines.

Coal No. 1, which at Mineral Ridge is above the base of the ridge on the south side, plunges under the valley in passing southward along the line of the Niles and New Lisbon Railway. McKinnie Shaft and Ohltam Shaft, sunk within one mile of Mineral Ridge, on low ground, are each over one hundred feet deep. The coal here, as on the ridge, is found in two layers, with a stratum of blackband ore and shale separating the benches; but at Weaver's Corners, two miles further south, the seam has united again, and appears as a homogeneous mass. The coal is here one hundred and fifty feet below the surface. South of this point no mine has been opened, and little coal has been found. Eastward a series of mines—the Foster Shaft, the Osburn Shaft, and Powers Slope, etc.—form the base line of the most southerly openings of Coal No. 1 in the Mahoning Valley. That coal exists still further south can admit of little doubt; but the increasing depth of the seam below the surface, reaching two hundred and forty feet at the Foster Mine, prevents any vigorous search for it. The application of steam for the purpose of boring, coupled with ability to raise cores of the strata, as is done with the hollow diamond drill, will, however, induce the mining and iron manufacturing companies to renew the search, and many mines will be found in the future, as in the past, where coal was believed to have no existence.

As a general rule, the hills are not as high in the mines of the Massillon region as in the Mahoning Valley. There are, however, some high hills near Massillon, one of which, as seen in the slope at Canal Fulton, rises to sixty feet, then dips over into an adjoining swamp, the coal bravely holding on all the way, though reduced in thickness to six inches on the high arch. Very frequently the coal seam is cut away by the white roof appearing before the coal has risen twelve to fifteen feet above the swamp.

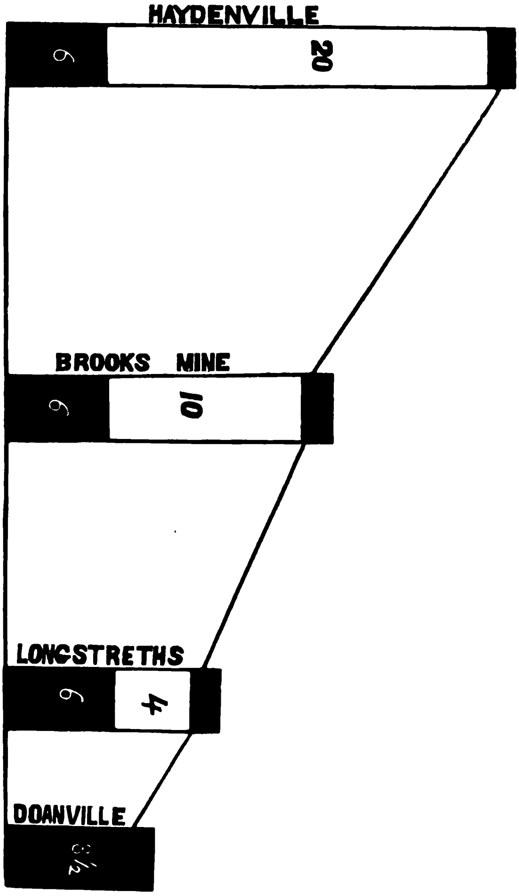
In the Maple Grove Mine a sand-bar cuts the coal out on the west side of the main swamp. The bed is of good thickness until this fault is met, when not only the coal but all the incumbent strata are cut away, and their places filled with sand. These sand-bars are of frequent occurrence in this valley. Sometimes they come down to the coal, all the shale above it being removed, while the coal itself is found in place. These faults are generally met in mines with a light cover. Where the cover is light, both in the Tuscarawas and Mahoning Valleys, the roof is soft and friable, and the coal between the face and butt slips filled with clay.

COAL NO. 6, AND ITS ASSOCIATE STRATA IN THE GREAT VEIN REGION.

The great thick coal of Perry county, popularly known as the "Great Vein," is the equivalent of the Nelsonville seam of the Hocking Valley. In all the mines of the Hocking Valley above Doanville the coal is from five feet ten inches to seven feet thick. At Doanville, Floodwood, and Hamley's Run it is eight to eight and one-half feet thick. At Straitsville and Shawnee it is nine to eleven feet thick, and at Ewing Site, on the Lower Sunday Creek, and at Buckingham and Ferrara it rises to twelve and thirteen feet. The additional height over seven feet is due to the union of two seams of coal, and to the enlargement of the upper of the two beds after the coalescing of the seams. In Peter Hayden's mines, in Haydenville, opened near the northern margin or outcrop of the coal, the two beds are twenty feet apart, but in going down the Hocking Valley they are seen to gradually approach each other, until at Doanville mines, on the left bank of the Hocking River, and at Floodwood, on the right bank, they come together, forming one seam so perfectly that not even the judging eye of the practical miner can detect the point of coalescence.

The upper seam is seen in all the mines of the valley; it is not persistent, however; but where wanting, the want is plainly the result of denuding forces, the coal and shale intervening between the sandstone strata and the main bed of coal having been removed by wash-faults, and their places usurped with a mass of fire-clay, or friable sandstone, a very bad and treacherous roof over the heads of the miners.

At Haydenville, as I have said, the two coals are fifteen to twenty feet apart; at Brooks's mines, three miles below Hayden's, they are five to ten feet apart; at Poston's and the Coöperative mines, below Brooks's, they are four to six feet apart; at Longstreth's, a mile below Poston's, they are three to five feet apart, and at Doanville they have coalesced. On the opposite side of the river from Doanville, in the Floodwood mines, the point of union is seen to occur in this mine. On the western side of the workings the two seams are one to four feet apart; but after the junction is formed on the eastern side they remain united, adding two feet of height to the coal.



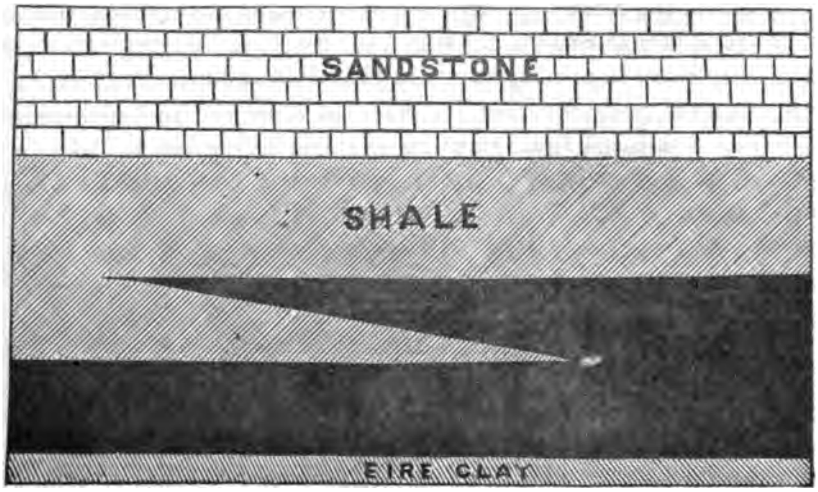
COALESCING OF THE TWO SEAMS IN HOCKING VALLEY, WHICH FORM THE "GREAT VEIN."

In the Hamley Run Shaft, two miles below the Floodwood Mines, a wedge of slate, three to six inches thick, divides the coals, but in the Salina Shaft, one and one-half miles below Hamley's Run, this shale has disappeared again.

Passing northward from the Floodwood and Doanville Mines, the upper coal continues to increase in thickness from a two to a five-foot stratum, making the Straitsville and Shawnee Coal Measures ten and eleven feet. At Buckingham, where thirteen feet two inches of height is met, the middle bench, usually less than four feet thick, has enlarged to five or six feet.

The area of the great thick coal, resulting from the union of the two seams, does not occupy more than forty or fifty square miles. Shawnee is the limit in the north-west; a point no great distance north from Ferrara is the limit on the north-east; a mile east of Ewing Site is the south-east limit, and Doanville and Floodwood is the margin on the south-west. Of course vast areas outside of these limits contain the coal in height varying from four to seven feet, as in the Nelsonville district, and the regions between Shawnee, Somerset, New Lexington, etc.

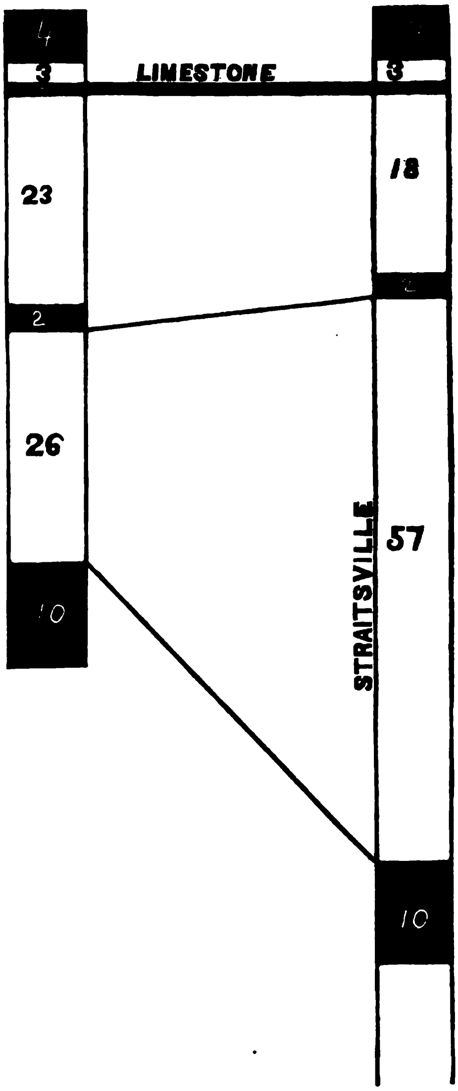
At Shawnee the coal thins down from nine and a half feet to five and a half feet, and north of Shawnee the five and a half feet gradually decreases till, at Somerset, and along the Muskingum Valley Railroad to Zanesville, four and even three feet is all that is left of the magnificent ten and eleven-foot coal. The first notice of the thinning of the coal at Shawnee occurs in the mines of the New York and Straitsville Coal Company. A thin wedge of shale appears in the coal about four feet from the top. This shale gradually increases in thickness, taking the place of the top coal, finally cutting it out altogether. The seam does not split into two continuous parts, as in the Hocking Valley, for, as soon as the shale has increased in thickness so as to cut away the top coal, no trace of it is ever seen afterward. I have examined the strata overlying the coal at Cunesville, Bristol Tunnel, and other points where the coal is five feet or less in thickness, and though the shales were twenty to thirty feet in thickness no vestige of the lost top coal could be seen.



Manner in which the Great Thick Coal at Shawnee is reduced from 9½ to 5½ feet.

The high bluffs in the Hocking Valley, at and below Nelsonville, as well as at Straitsville and Shawnee, and the numerous coal openings, afford an excellent opportunity for measuring the thickness of strata lying between the different beds of coal in these three districts, and thus of settling, by the best of proofs, the question of the "parallelism of coal seams." On page 347, Vol. 1, Geology, Professor Andrews says: "One careful measurement of the interval between two seams is so excellent a guide that, either seam being found, the place of the other can be readily determined. There may be difficulty in ascertaining the exact interval, because there may be considerable horizontal distance between the exposures of the seams, and calculations must be made for the dip, usually an unknown term, but when the measurements are accurate the parallelism is perfect and beautiful. There is a little play of variation sometimes, but it is generally very slight." In this view Professor Andrews is supported by Professor Dana, the eminent mineralogist, but the facts are against them, however plausible and beautiful the theory may be. The intervals between the various coal seams recorded in the following pages occur, in most instances, in the second Geological District, of which Professor Andrews had charge as Assistant Geologist of the late Geological Survey, but the same conditions are found in every coal district of the State. The measurements were in no case taken by the barometer, that instrument not being deemed sufficiently reliable, but by the tape-line and engineer's level. Four seams of coal, No. 5, No. 6 (the Great Vein), No. 6*a* (the Norris coal), and No. 7 (the Bayley's Run coal), are very persistent beds in the Hocking Valley districts. No. 6 (the Great Seam) is mined in thirteen mines in the Nelsonville district, in nine in the Straitsville district, and in six mines at Shawnee. Wherever No. 7 (the Bayley's Run coal) is due, it is found from sixty-five to one hundred and five feet above No. 6, having an average thickness of four feet, and wherever No. 5 is due above water-level it is found from eighteen to thirty feet below the horizon of No. 6. With the assistance of Mr. Thomas Berry, superintendent of Longstreth's Mines, at Nelsonville, Mr. James Findlay, superintendent of the Newark Coal Company's Mines, at Shawnee, and Mr. D. W. Roy, superintendent of the Central Mines, at Straitsville, I measured the distance between these coals at the above named mines, using an engineer's level to insure precision. At Longstreth's Mine the distance between Nos. 5 and 6 is twenty-one feet eight inches, measuring from floor to floor of the seams, and the distance between Nos. 6 and 7 is seventy-five feet one inch. The distance between Nos. 5 and 6 at the Newark Coal Company's Mine, at Shawnee, is eighteen feet, showing a convergence of three feet two inches from Longstreth's, and the distance from No. 6 to No. 7 is sixty-three feet, showing a convergence from Longstreth's of twelve feet one inch. These mines are about ten miles apart. The distance between Nos. 5 and 6, at the old Straitsville Mine (No. 5 being below water-level at the Central Mine), is twenty feet ten inches; showing a divergence from the Newark Mines, at Shawnee, of eleven feet four inches, and from Longstreth's Mine, at Nelsonville, of eight feet two inches. The distance between Nos. 6 and 7, at the Central Mine, at Straitsville, is ninety-two feet; showing a divergence from the Newark Mine of twenty-nine feet, and from Longstreth's Mine of seventeen feet. The Newark and Central Mines are two miles apart. Between No. 6 and No. 7, No. 6*a* (the Norris coal) is present at all these mining properties, and it diverges and converges like its associates. This seam is only two feet thick at Straitsville and Shawnee, and is still thinner in the Hocking Valley, at Longstreth's Mines, but at this latter point it had a sandstone roof, and was doubtless partly pared away by the sand when it formed over the coal. Further down the valley the coal is wanting altogether. Several holes drilled by General Thomas Ewing in the lower Sunday Creek Valley for the Great Seam also show marked converging and diverging of the Bayley's Run and Great Vein coals, Nos. 7 and 6. Five bore-holes were sunk by General Ewing, the most northerly of the series being put down at Mud Fork, a few rods west of the Allen bank. The distance between the coals in this hole, counting from floor to floor, is sixty-seven feet. Two and a fourth miles north of this hole, at Ewing Site, another one was bored, and the two coals were found ninety-six feet two inches apart, showing a divergence of twenty-nine feet two inches. The other three holes showed respectively eighty-two feet, seventy-two feet, and seventy-four feet between the coals. One of the holes bored on Bayley's Run, which shows seventy-four feet between the coals, lies nearly north of Ewing, where the coals are ninety-six feet two inches apart, being a convergence of twenty-two feet two inches, but within two and a fourth miles of the Bayley's Run hole the Chauncy Shaft is sunk, and in this shaft the coals are one hundred and five feet apart, being a divergence of twenty-one feet. From the Mud Fork hole, near the Allen bank, the most northerly of General Ewing's series, to the Chauncy Shaft, there is a divergence of thirty-eight feet, the distance being seven miles in a straight line. These facts, as I have said, are illustrated in every coal region of the State, and are due to the undulations in the coal-floor, one seam dipping into a low place or depression, while the seam above it may be rising over the same line.

The following cut shows the position of the three coals at Straitsville and Shawnee. The limestone which underlies No. 7 is supposed to be level on the cut, but this is of no consequence, as the object is to show the varying thickness of strata between the coals:



Coal No. 5 is eighteen and one-half feet below No. 6 at Shawnee, and is thirty feet below it at the Straitsville Mining Company's mine. The Great Vein, the only bed in course of development, illustrates the manner in which the various seams of coal converge and diverge. The general dip at Straitsville is south-east, but there are departures from the usual dip on the part of some of the seams. For example, the Plummer Hill, the Straitsville Mining Company's mine, and the Central Mine, all three opened on the south side of the railroad in an eastern line, have different dips, the Plummer Hill and Straitsville dipping south-east and the Central due south. The main opening of the Central, fronting the railroad, is thirty-two feet higher at the entrance of the mine than the outcrop of the coal on Lost Run, on the other side of Black Snake Ridge, the line of direction being south five degrees west, and the distance three thousand feet. Coal No. 5 is below water-level at the south opening, and the distance between it and No. 6 is not known; but the distance between No. 6 and No. 6*a* and No. 7 has been measured by means of an engineer's level, and are as stated in the cut, to wit, from the floor of No. 6 to No. 6*a*, fifty-seven feet; from No. 6*a* to No. 7, twenty-three feet. On the other side of Black Snake Ridge No. 6 and No. 7 are eighty-three feet apart (No. 6*a* not being exposed), showing a convergence of nine feet. Thus, while No. 6 dipped thirty-two feet in three thousand feet on a line south five degrees west, No. 7 dipped only twenty-three feet over the same line.

The convergence and divergence of coal seams, and the splitting of a seam into two or more parts, as well as the coalescing of two or more seams, are facts of practical geology not confined to the Ohio coal field, but are met in every mining region of the world where the mining developments have laid bare strata by shafting. The best field for the proofs of these facts are found in the British coal regions. In England, Scotland, and Wales there are three thousand coal mines, varying in perpendicular depth from one hundred feet to two thousand four hundred feet. In many of the pits ten and twelve different seams are passed through, and frequently the coals of three and four different beds are raised from the same shaft. The strata between the different coal beds have been measured in hundreds of cases, and the fact of divergence and convergence are understood by every mining geologist, every mining engineer, and every practical miner in Great Britain. A remarkable case of the splittilg of a coal bed occurs in the great thick coal of south Staffordshire, where that seam, ranging from twenty-four to thirty-six feet at Dudley, Billston, and Wolverhampton, splits up into eight different beds at Cannock Chase.

In Lanarkshire, Scotland, the Main coal and Pyotshaw, two seams of coal, each about four and a half feet thick, form a double seam, the Pyotshaw resting on tne Main coal. A thin wedge of shale finally appears between the coals, which gradually increases in thickness to thirty feet in a distance of two or three miles. The various coal beds of Great Britain thin out and disappear in many places where they are due, like the coal beds of our State. The "splint" coal, a superior iron-making coal, is a well-known seam throughout Lanarkshire. Its position is about eighty-four feet below the celebrated "blackband iron-stone," which is also frequently wanting where it should exist. At Eastfield the splint coal is present, but the blackband is absent. On the river Clyde, near the city of Glasgow, and at Lesmahago, the iron-stone is found, and mined in both places, but the splint coal is wanting. The celebrated "boghead" coal has also no existence at Eastfield.

The block coal region of Indiana contains two furnace coals, which are both worked. Both occupy very undulating floors, being deposited in basins or swamps, somewhat after the basins in the Jackson county district of Ohio. As the coal rises in the hills it thins out, and the basins of such seams appear to be so located that the two coals are seldom found one below the other in minable thickness; if the upper one is in place the lower one is generally wanting, and vice versa.

The Nelsonville coal, which at Haydenville is one hundred and fifty-five feet above the level of the railroad, dips much more rapidly than the Hocking River in descending the valley. At Hamley's Run, ten miles south-east of Haydenville, the coal plunges under the Hocking River, and is reached in Hamley's Run by a shaft sixty feet deep, and at Athens, ten miles below Hamley's Run, another shaft, one hundred and ninety-six feet deep, taps the coal. Coal No. 7 (No *6a* having thinned out) is level with the Hocking River at Chauncy, and is ninety feet below the railroad in the Athens shaft.

Three and a quarter miles west of Athens, on Factory Run, along the line of the Marietta and Cincinnati Railroad, No. 7 reappears above the creek, and is opened in several places on the De Steugher farm. From Athens to De Steugher's the railroad is nearly level, but westward, to Marshfield, it rises rapidly, Marshfield being one hundred and forty-seven feet higher than De Steugher's. No. 7 is re-buried about midway between these places, and is forty feet under the railroad at Marshfield. From Marshfield to Mineral City the descent is one hundred feet in three miles. No. 7 crops out on the bank of the railroad half a mile west of the former place, and No. 6 rises above the bed of Hewett's Fork, three-quarters of a mile east of the latter. At Mineral Station this coal is above the railroad level, and is opened on the north side of the track.

The Carbondale mines, five miles north of Mineral Station, are opened in No. 6, or the Nelsonville coal. The seam is a little thinner than in the mines at Nelsonville and Lick Run, but this is its history west of the Hocking Valley. The heavy sandstone which overlies the coal in the Nelsonville mines, and separated from it by a wedge of shale from four to twenty feet thick, frequently comes down on top of the seam at Carbondale, and pares away part of the upper bench. Where there is a good thickness of shale between the sandstone and coal, the thin stratum of coal seen in the roof shale at Nelsonville is found in Carbondale. Ninety to one hundred feet above the main bed the Bayley's Run coal is found in the same hill as the Nelsonville seam. It, too, is reduced in thickness, showing only two feet eleven inches of height.

From the Carbondale mines to Mineral City the coal railroad runs down Hewett's Fork and exposes Coal No. 6 in numerous places. The massive sandstone overlying the coal frequently comes down to the seam along this run, reducing the height of the bed; and this condition is met in the mines at King's Switch, and further west, along the Marietta and Cincinnati Railroad.

A year or so ago a hole was drilled at Mineral City for the Nelsonville coal, an opinion prevailing that the Carbondale and Mineral City [illegible] was a stratum higher up in the series, the equivalent of the De Steugher coal, which is the Bayley's Run bed. At eighty feet the coal-drillers reported striking a seam seven feet thick, and this was claimed to be the equivalent of the Nelsonville seam. The drillers doubtless struck coal about eighty feet in depth from the surface, though not the Nelsonville bed, but Coal No. 4, known along Hewett's Fork as the "Slate Vein." This coal often splits in two on Raccoon Creek, the parts diverging four to six feet, the intercalated material being "chip slate," which resembles cannel coal and burns into a white shale.

Practical men are not all agreed as to the Carbondale and Nelsonville coals being equivalents, and a six-foot seam, known as the "Collins coal," lying two miles north of the Carbondale mines, is referred to as a lower seam; but this stratum is beyond all question the equivalent of the Carbondale coal. Its horizon is about that of the mines at Carbondale, and so it should be, because it lies to the rise of the strata. The fact of its dipping under the ravine, as though it would appear well below the Carbondale mines if this dip were continuous, is of no consequence. Whoever follows the coal from Carbondale to Mineral City will see many "dips" and "rises," the seam being sometimes twenty to twenty-five feet above the run, and at other times coming down to its level.

From Mineral City to Hamden the general direction of the railroad is west of south, and the strata rise all the way. At King's Switch, two miles west of Mineral City, the Carbondale or Nelsonsville coal is twenty to twenty-five feet above the road, and No. 5 comes to day. At Moonville, Mr. Coe's mines, opened on No. 6, are seventy to eighty feet above the road, and No. 5 is about sixty feet above Racoon Creek. On the south bank of the creek No. 4 is split in two, the parts being four to six feet apart, with "chip slate" between them. Over the coal a calcareous shale, the representative of the "Putnam Hill" and "Ferriferous" limestone, appears, and this is capped with the "limestone ore." In the first cut west of Mr. Coe's house No. 4 is above the railroad at the east end, but buries itself at the west end. It, however, reappears in the Near and Mash cut, a few rods west, and is seen to rise gradually. The limestone ore invariably overlies the coal, but the limestone is not present, being represented by calcareous shale at Brewer's Cut, one mile west of Hope Station. No. 4 is ten to thirty-five feet above the railroad, and the calcareous shale overlying the coal has become calcareous sandstone.

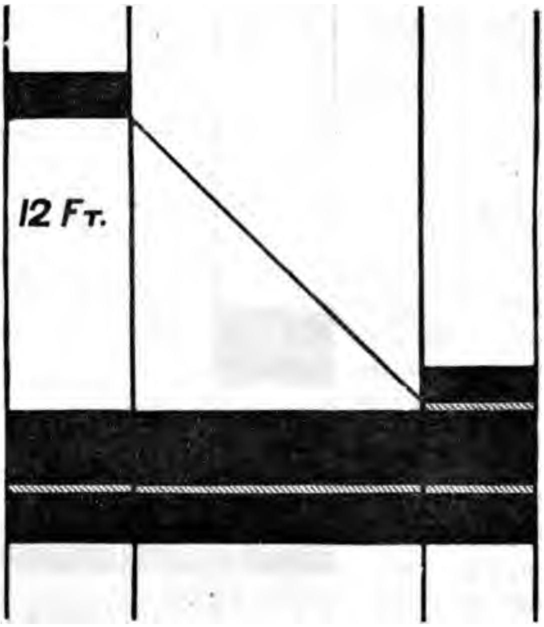
A little south-west of this cut, Coal No. 3 rises above water-level, and is capped with a stratum of calcareous shale two and a half feet, the representative of the blue limestone. At Coalmont this coal is nearly level with the railroad, and at Zaleski it is above it, and is called the "Dowd

Vein." The coal has been opened by the Zaleski Company on the north side of the road. It is nearly four feet thick, approaching a cannel in character, but its quality is not good. No. 4 is also opened by this company one-half mile north of the railroad, and is known as the "Furnace Vein." It is fifty-two feet above No. 3, but it is opened on the rise of the strata, and when due allowance is made for this "rise," the distance between these seams will be about forty feet. No. 6 is the seam mined by the Zaleski Company at Coalmont; No. 4 has been opened there also, but is not working at present. The vertical distance between No. 4 and No. 6 at Coalmont is sixty-two feet. Between No. 4 and No 6, No. 5 is present in a three-foot coal twenty-two feet below the horizon of No. 6. Twenty-two feet below No. 5, and eighteen feet above No 4, the limestone ore is exposed. It measures from four to ten inches in thickness, and is underlain with the equivalent of the Ferriferous sandstone from two to six feet thick, though the limestone itself is sometimes present. Southward of Zaleski the limestone is constant and increases in thickness. At Coalmont No. 6 is about one hundred feet above the Marietta and Cincinnati Railroad, and has seventy to eighty feet of cover. No. 7, the Bayley's Run Coal, is not present for want of mountain height. At Zaleski, Mine No. 4 is, as I have said, forty feet above the railroad, and above it No. 6 is present, but the hill is too light to hold a strong cover over the coal.

The Vinton Coal and Iron Company have a shaft sunk to Coal No. 1 at their iron works. The shaft is one hundred and seventy feet deep, and the Ferriferous limestone is thirty-five to fifty feet higher, making this limestone about two hundred and fifteen to two hundred and twenty-five feet above Coal No. 1. Coal No. 3 is here, as at Zaleski, a cannel, especially the lower part of the seam. No. 4, twenty-five feet above No. 3 is four feet six inches thick, which is about its height at Zaleski, including the two shale partings. The Ferriferous limestone lies about eighteen feet above Coal No. 4 on the Vinton mining property.

South-west of Zaleski, along the line of the Marietta and Cincinnati Railroad, No. 6 has no existence for want of mountain height, and the Ferriferous limestone and its associate ore are the highest members. No. 4, underlying the limestone, is a seam of workable height every where south of Coalmont, as also No. 3, but this latter coal, usually part cannel, is not esteemed for household purposes as highly as No. 4, and is not much mined.

Coal No. 4 has a remarkable tendency to split up into two parts, the intercalated material being sometimes fire-clay and sometimes shale. At Zanesville the two parts are ten feet apart. Along the line of the Marietta and Cincinnati Railroad, between Moonville and Zaleski, this seam is split up in nearly every railroad cut. At the Zaleski Mine the coal splits in two parts in the west entry, and the parts continue to gradually diverge to the east until the intercalated material is twelve feet in thickness. On the opposite side of Raccoon Creek several openings have been made in this seam, and the upper stratum of the coal which spilt off, in the Zaleski Company's mine, is there twelve to fifteen feet above the lower part of the seam. Cases of a like character are frequently mentioned in the Geological Rports by Dr. Newberry.



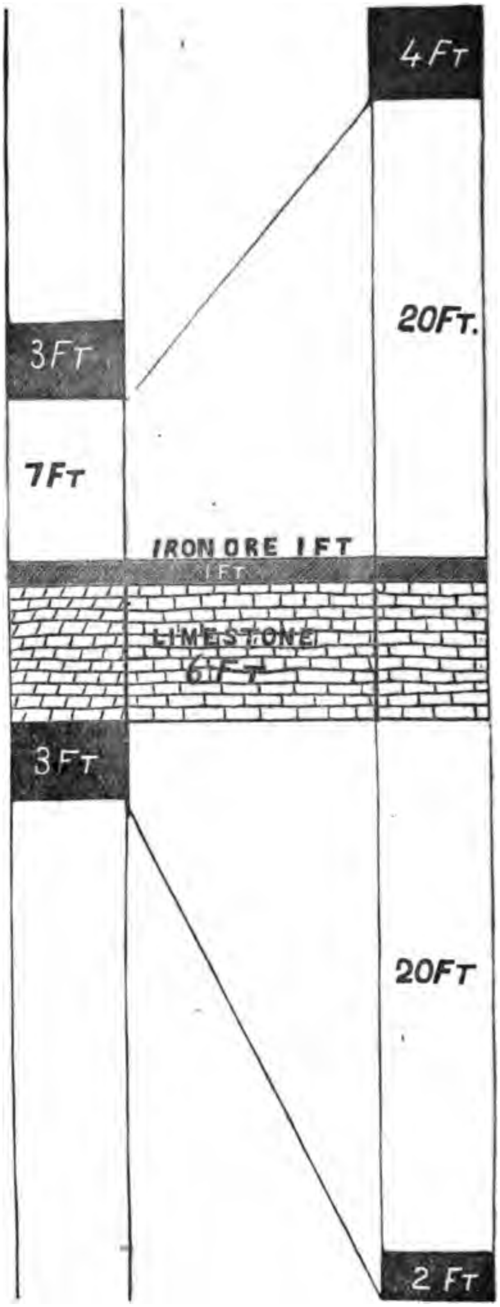
SPLITTING OF COAL NO. 4 IN THE ZALESKI COMPANY'S MINE.

THE FERRIFEROUS LIMESTONE.

The horizon of the Ferriferous limestone and its associated bed of iron ore is located by Prof. Andrews in the Geological Reports immediately above No. 6, the Nelsonville or Great Vein. This is plainly a mistake. The true place of the Ferriferous limestone is between No. 4 and No. 5, frequently directly over No. 4; and this limestone and the Putnam Hill limestone of the Geological Reports are equivalent strata.

The Ferriferous limestone is a marked and well-known feature of the strata in the counties of Vinton, Jackson, Lawrence, and Scioto. It extends almost continuously through Jackson, Scioto, and Lawrence counties wherever it is due, varying from two to ten feet in thickness. In Vinton county it passes from limestone into a calcareous sandstone, thence to a calcareous shale, but the bed of iron ore never disappears in these counties. At all points the limestone or its equivalent is capped with the stratum of iron ore.

On page 93, in the second Volume of the Report of Progress of the Geological Survey, 1870, it is stated that from Union Furnace, Star township, Hocking county, to Brewer's Cut, in Vinton county, on the line of the Marietta and Cincinnati Railroad, in a distance of ten miles a difference of sixty feet occurs between the strata separating the Putnam Hill limestone and the Nelsonville seam of coal, and on page 62 a diagram is given showing the manner in which the subsidence occurred. This is all wrong. The calcareous shale overlying the seam of coal one-fourth of a mile south-west of Brewer's Cut is not the equivalent of the Putnam Hill limestone overlying Coal No. 4, but the equivalent of the blue limestone overlying No. 3. In Brewer's Cut, Coal No. 4, split up into several strata, is ten to thirty-four feet above the level of the railroad, and No. 3 has not yet emerged above the waters of Raccoon Creek. The horizon of the Ferriferous limestone is also not immediately over Coal No. 6, but is over No. 4.



Divergence of Coals Nos. 4 and 5.

Coals Nos. 3 and 4 are constantly diverging and converging, wherever they are exposed, in all parts of the coal field. In the counties of Vinton, Jackson, Lawrence, and Scioto they are sometimes within fifteen and twenty feet of each other, and are sometimes found forty and fifty feet apart. Wherever the seams approach each other within twenty feet the Ferriferous limestone often lies directly over Coal No. 4, forming the roof of the seam; and wherever they are forty or fifty feet apart the limestone is found about midway between them. The diagram on page 154 illustrates this matter. The place where the limestone overlies the coal from which the illustration is taken is in Scioto county, six miles north-west of the iron tunnel, in Lawrence county, this latter place showing the coal fifty feet apart, with the limestone in the middle of the space.

Numerous borings have been made in the neighborhood of Hamden in the hope of striking either the Wellston or the Jackson coal, but success does not appear to have rewarded the mining adventurers. It is to no purpose to hope to find the Wellston coal below the horizon of the two-foot seam which crops out in the bluffs surrounding the village, for THAT is the Wellston bed risen from below the surface at Wellston to a level-free bed at Hamden, and thinned from a four-foot to a two-foot coal. The Jackson coal does not appear to exist at Hamden, owing to the Conglomerate rock rising to within sixty or seventy feet of the Hamden coal. None of those troughs or swamps in which this coal reposes appear to have been scooped out of the Conglomerate around Hamden. Still, no amount of practical experience will enable the mining engineer to say where the Jackson coal will or will not be met. There is but one way to achieve success. Keep exploring by boring until either coal or the Conglomerate is encountered.

COAL NO. 1, IN JACKSON COUNTY.

The Jackson Hill coal and the Wellston coal are one and the same seam, the horizon of which is about one hundred feet above the Jackson Shaft coal. Between these seams there is sometimes a thin bed present. In sinking the Orange Shaft this coal was passed through, but it was less than a foot thick. In some other parts of Jackson county it is present in better development. The Wellston coal is disposed on a much more even floor than the Jackson Shaft coal, the inequalities of level encountered in the mines seldom exceeding five feet. At Petrea this coal is accessible by drift mining. At Wellston it is seventy-five feet below the surface in one of the shafts, and forty-five feet at the other. A mile north of Wellston it crops out in the creek, and becomes reduced in thickness from four to two feet. East of Wellston, at Raccoon Creek, the coal has been found eighty feet below the surface, and four feet thick. West of Wellston seven miles it again crops out, and is less than three feet thick. At Hamden it is also level free, and has been opened in numerous places to the east of the village, but it is too thin to be of any immediate commercial value.

The Jackson county shaft coal is the lower coal, or No. 1, the equivalent of the Mahoning Valley and Massillon coals. This coal bed seems to be every where disposed on a wavy and uneven floor, and to be wanting altogether over large areas where it is due. In the Mahoning Valley the troughs or basins which hold the coal are generally long, narrow, and serpentine, but in the Massillon region, and in Jackson county, they are wider, and the coal rises over the hills and sinks into the adjoining troughs or hollows without a break, though with a gradual thinning of the bed in ascending the hill-sides. There is seldom any wants or thin coal found in the low places in the mines, caused by sandstone or fire-clay ursurping the place of the coal, such as are encountered in the majority of the mines in the Mahoning Valley.

Of the nine openings in and around Jackson village, inclosing an area one and one-fourth miles long and three-fourths of a mile wide, there is a continuity of the coal from one mine to another, except where the erosions of the valley have cut down through the coal. The hills are nearly as high in these mines as in the Mahoning Valley mines, but in the Jackson district the coal invariably dips over into an adjoining trough or basin without disappearing in the hill tops, and without encountering any foreign roof of sandstone or fire-clay.

One-fourth of a mile west of the Globe Slope, however, there is a break in the coal strata, caused by a high arch of the Conglomerate rock rising fully fifty feet above the coal-level in the hollows or troughs of the mine. At the site of the old Diamond Furnace this rock is exposed on the surface. Westward of this point, at the Jackson Furnace, the coal reappears in proper place and thickness. One-fourth of a mile north-east of the Star Furnace the coal has been sunk for and found thin (not exceeding two and one half feet), and is covered with a fragile roof, indicating the approach of barren ground. Less than half a mile north of the Globe Slope repeated borings have failed to strike coal, no trace of the seam being encountered. These wants should not discourage the mining adventurer—productive ground must be sought for at all points where this coal is due, at great risk and expense. As in the Mahoning Valley, no amount of practical experience or scientific attainments will avail the explorer in searching for coal. All the aid the geologist and mining engineer can give is to determine the boundary of the coal strata, outside of which coal has no existence, and inside of which there are many wants, or breaks, in the coal bed.

The high arch of the bottom rock, at the site of the old Diamond Furnace, is not due to any bending or uplifting of the lower strata. The basins on both sides of this arch were scooped out of an originally extended level plain, anterior to the deposition of the coal vegetation, and the bottoms of these basins were once deeper than they are now, having been subsequently filled up for several feet, sometimes with a muddy sediment, and sometimes with sand washed down from the hill-sides. The sides of the troughs are also frequently lined with this newer matter for a few feet in depth. The immediate material upon which the coal rests on the hill-sides, therefore, conforms to the pitch of the coal and the roof shales, but as the sides of the troughs are cut down to the coal-level in the swamps, the planes or cleats of the rock lie horizontal, or maintain their slight dip of twenty-five or thirty feet to the mile in a south-easterly direction. This condition of the coal floor is smetimes found in the Massillon region and in the Mahoning Valley. The sediment which lined the hill-sides and swamps were sometimes sand and sometimes clay or black mud, now sandstone, fire-clay, and shale.

IRONTON REGION.

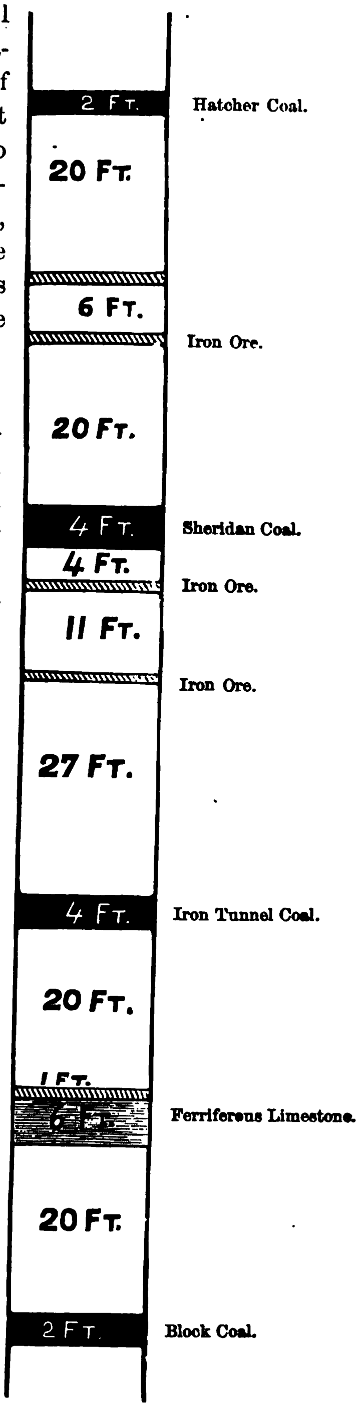
The Newcastle coal and the Iron Railroad coal are equivalent beds, and are the equivalents of Coal No. 5. The Sheridan seam is a bed higher up in the series, and is the equivalent of the Nelsonville coal, and not of the Bayley's Run coal, as stated in the Geological Report. The Hatcher coal, a seam fifty feet above the horizon of the Sheridan seam, is the equivalent of the Bayley's Run coal. The Iron Tunnel coal and the Newcastle coal lie from ten to twenty feet above the Ferriferous or Putnam Hill limestone. About twenty feet below the limestone, at the Iron Tunnel, Coal No. 4 is exposed. It is called the block vein, and is only about two feet thick. Between the Iron Tunnel and Ironton a bore-hole was cut some time ago, which passed through No. 3 and No. 2, but No. 1, the equivalent of the Jackson Furnace coal, appeared to be wanting.

About ninety feet above the horizon of the Hatcher coal, on the lands of the Sheridan Coal Company, there is a massive bed of sandstone, the lower fifteen or twenty feet of which is conglomerate rock. Higher up in the barren measures, about two hundred and twenty feet above the Hatcher coal, a stratum of coal exists, said to be two feet thick. This is doubtless the representative of the two-foot coal lying in the barren measures at Steubenville, which is there about the same distance above the Steubenville shaft coal, that coal and the Hatcher coal being equivalent beds, and both the equivalent of the Bayley's Run coal. The two-foot coal of the barren measures is also exposed in the hills on the lower Sunday Creek Valley of Athens county, and doubtless runs through the whole coal field. One or two thinner seams are also met in many places of the barren measures

MUSKINGUM VALLEY REGION.

Half a mile north of Moxahala tunnel the mines of Messrs. Black & Son are opened on a five-foot seam of coal thirty to forty-five feet above the Big Vein. This is the equivalent of the two-foot coal at Shawnee and Straitsville, overlying No. 6 there. The Big Vein is seen in the creek at the chutes of Black's mine. Its thickness is only five feet, while a mile south of the tunnel it is thirteen feet thick. The manner by which this coal has fallen from a thirteen-foot seam to a five-foot one, in a distance of two miles, I have not determined.

The coal in Black's mine is disposed on a very irregular floor. In the west entry the dip is fifteen feet in three hundred yards; then the entry commences rising out of the swamp at the rate of one foot in six. The mines of Straitsville and Shawnee show nearly equally marked changes of level. In the Central Mine of Straitsville the main entry following the face of the coal to the south has a south dip of one foot to the hundred, but in the butt entries, running east and west, more rapid changes



Section of Coals and Ores at the Sheridan Mines, Lawrence County.

occur. One of these dips is sixteen feet in two hundred and fifty yards. In the Troy Mine a sixteen-foot dip or swamp occurs in a still shorter distance. These swamps are not formed by the folding of the strata after the Carbonaceous age, but by erosion in the floor of the coal-bed anterior to the deposition of the coal vegetation. Their line of direction is southeast along the dip of the coal strata. At Black & Mahler's mine, at Moxahala, No. 6 is under water. One and a half miles north of this point, on Moxahala Creek, the seam emerges from the water, and is opened and mined by drifting at Lexington. Passing thence along the Cincinnati and Muskingum Valley Railroad to Zanesville, a dozen level-free mines are operated in No. 6. At Del Carbo, seven miles south of Zanesville, two seams are worked, Nos. 5 and 6. They are separated by twenty-two to twenty-six feet of strata. The lower coal is a homogeneous mass, five feet thick, of excellent quality, and easily mined, but it is not persistent. It is due at all the mining properties on the Muskingum Valley road, but its existence is not known, and the probability is that it is not persistent. In the Del Carbo Mine it is disposed in an oblong basin, the width of which varies from one hundred to three hundred yards. There is a swamp or low place in the middle of the basin twenty-two feet lower than its flanks. The coal rises out of this trough on both sides, losing height in doing so, but there is still a good workable thickness, when a fire-clay roof appears, and gradually but surely cuts the coal away, the fire-clay usurping the place of the coal. On the opposite side of the valley the coal is present and is being opened up.

Forty or fifty feet below the horizon of the lower coal at Del Carbo mines, Coal No. 4 appears in the bed of George's Creek. The seam is too thin to be of commercial value and appears in two parts, each stratum being less than one foot thick. A stratum of fire-clay, two feet thick, separates the parts. The coal is capped with a band of limestone, the "Putnam Hill" and "Ferriferous" limestone of the Geological Survey. A stratum of red ore rests, in turn, upon the limestone.

Near the water's edge of the Muskingum River, at Zanesville, on the south side of the stream, a thin seam of coal shows itself. It has a cover of two feet of shale, followed by a stratum of limestone a foot thick; the limestone is, in turn, covered with a band of reddish ore fourteen inches thick. This is Coal No. 3. Eighty feet above this seam, measuring with the barometer, No. 4 exposes itself in the steep bluffs fronting the river. It is here, as at Del Carbo, a double seam; but the intercalated material is shale, and is ten feet thick. Each stratum of coal is about one foot in thickness. The Putnam Hill limestone forms the cover for the coal. A slip dike shows itself in the bluff on the south side of the river, opposite the Court-house, the change of level reaching six or seven feet.

The two coals worked at Del Carbo mines, Nos. 5 and 6, are not present in the bluffs on the south side of the river at Zanesville, for want of mountain height; but on the opposite side, on the high lands north and east of the city, both seams are mined in forty different openings. These beds are from twenty-seven to thirty-three feet apart, the upper one being seventy-five feet above the Putnam Hill limestone. The lower of the two, No. 5, is, as at Del Carbo, subject to "cut-offs," as the miners there call the "horsebacks" which cut out the coal and usurp its place.

From Zanesville to Marietta the Muskingum River flows in a general south-east direction along the dip of the Coal Measures, and hence the two coals at Zanesville, one hundred and twenty and one hundred and fifty feet above the river there, plunge under water in passing down the river. No. 6 only is mined below Zanesville, and is last seen at Philo. All along the Muskingum Valley Railroad, from New Lexington to Zanesville, and along the Muskingum River, from Zanesville to Philo, this coal seldom rises to four feet, and it loses height on passing down the river, till where it plunges under water, below Philo, it has dwindled down to a two and a half foot seam, only the two lower benches being present, and these in reduced height. At all points, however, in the above-named districts, it is easily mined, yielding to the blows of the workmen's picks, and neither powder nor wedges are seen in any of the mines.

The Cedar Run and Blue Rock coal, below Philo, is the equivalent of the Bayley's Run coal. Its horizon is ninety to one hundred feet above that of No. 6. This seam is here a very frush coal, easily mined, and poorly adapted to resist a crush of the overlying strata. Blue Rock was the scene of a dreadful accident, which occurred in a coal mine in the spring of 1856. The whole hill came down over a large area of the mine excavations and imprisoned four of twenty miners who were under ground when the crush came on. The miners who escaped, and all the workmen of the surrounding mines, as well as hundreds of people in other occupations of life, worked heroically for fourteen days and thirteen hours, rescuing the imprisoned miners. The unfortunate men were supposed to be dead after the first week of imprisonment, but on Thursday of the second week one of the rescuers heard the sound of human voices beyond the fall, and called the attention of his comrades to the fact. A miner, named Edwards, shouted through the rocks, and was immediately answered. The four entombed men were all alive, but were in the dark, the black damp having accumulated and put out every light in the mine.

They were all got out alive, and soon recovered. Two of them are now dead, but the other two, Edward Savage and William Edgell, are still pursuing their perilous occupation. Edgell was a soldier during the war of the rebellion, and had his left arm, below the elbow, shot away in battle. He has now a wooden arm and iron hand, and still swings his pick with the energy of former years.

The coal at Blue Rock is disposed on a very uneven floor, in a series of hills and troughs resembling the swamps and hills in Coal No. 1, in the Mahoning Valley.

There are numerous mines in the vicinity of McConnelsville, but they are all "country banks," working less than ten men, and so have not been examined.

The first mines of any extent met in passing down the river, below McConnelsville, are those at Coal Run, in Washington county. These mines are opened on the Pittsburgh coal, the equivalent of the Duck Creek Mines, at Macksburg. The coal is subject to numerous horsebacks—"clay veins" a foot or two in thickness—which increase the cost of getting the coal. The seam is double, as at Macksburg, the intercalated material, two to three feet thick, being a band of fire-clay. This coal is near the water's edge at high-water mark at Coal Run, and is lost under the river one-fourth of a mile below. Its horizon at Marietta would be from one hundred and fifty to two hundred feet below the bed of the Ohio River. No seam of value is known to exist in the bluffs fronting the river at Marietta.

LEETONIA.

The two seams of coal opened at Leetonia and Washingtonville are there known as Nos. 3 and 4, following Dr. Newberry's enumeration. The upper coal (No. 4) is the thinner but the more valuable of the two seams. The three mines of the Cherry Valley Iron Company, also the Grafton Shaft, the Salem Shaft, and the mine of Walters & Co., are operating in No. 4. The Salem Shaft (at present idle) and the Grafton Shaft have passed through both seams. These coals are usually about fifty feet apart, the distance varying more or less by reason of the undulations in each coal floor. Green Creek Valley exposes No. 4 at Washingtonville, and admits of drift mining; but at Leetonia, two miles south-west, the coal has plunged under the creek and is reached by sinking. The dip does not, however, appear to be marked. The Roller and Washingtonville Mines of the Cherry Valley Iron Company, both level free, are opened on the east side of Green Creek, the main entries extending north 45° east along the face of the coal, and the dip is nine feet in two thousand feet. The difference of level between the entrance of the Washingtonville Mine and the bottom of the coal in the Leetonia Slope is only twelve feet, the distance being one and a half miles, and the line of direction to the east of south—nearly on the true dip of the coal strata. The butt entries of the mines, which run north-west on the left of the face entry and south-east on the right side, annoy the miner more by reason of the undulations in the coal floor than by the natural dip. In the Leetonia Slope the main entry runs due west, and the water is discharged by drains cut in the coal floor. In the Grafton Shaft the main entry runs north 4° west, but it dipped nine feet under water into a local depression which submerged the workings in this part of the mine. As the cheapest way of getting rid of the water, the company bored a hole from Coal No. 4 to No. 3, in the lowest place of the swamp. The water rushes into this hole and discharges itself in the idle workings of the lower bed, and is pumped up out of the mine at the bottom of the pit.

The ridges and depressions encountered in the mines in this neighborhood are not as marked as in many other districts. The hills do not rise to more than nine or ten feet in height, and the inclination is very gentle. The coal is always thickest in the troughs and thinnest on the high ground, enlarging to three feet and dwarfing to fifteen inches. These waves of the coal floor are not due to any erosive agencies, as are the troughs and ridges in many other mines, but to gentle foldings of the strata. The coal sometimes rests on fire-clay and sometimes on black shale, but below the coal, from six inches to two and a half feet, there is a band of limestone usually six inches to two and a half feet thick. This limestone rises and falls, conforming with the coal on the hills and in the hollows. Below the limestone a band of fire-clay is always present. The roof of the mine is a dark shale, with a band of ore six inches thick running within six to eight inches of the top of the coal seam. Some of this ore has been mined and calcined at the pit's mouth for use in the blast furnace, but is too largely impregnated with silica to be of service. A bed of kidney ore two to three feet thick, and within three feet of the coal roof, is also present, but too costly, in view of the percentage of ore yielded, to be worked with vigor.

Passing upward into the roof for twenty to twenty-five feet, a massive bed of sandstone is encountered. A thin seam of coal is reported by the superintendent of the Cherry Valley Mines as existing sixty-five feet above Coal No. 4; but the Salem Shaft, which is one hundred and eighty feet deep, and is one hundred and forty feet deep before it strikes No. 4, does not show any coal deserving to be classed as a workable bed.

In the Salem Shaft the two coals (Nos. 3 and 4) are forty feet apart, showing a convergence of the seams of ten feet in five miles. Whether this was due to a gradual approximation of the coals, or to the unconformable character of the ridges and hollows in the two mines, I know not. This mine was idle at the time the region was visited.

SALINEVILLE.

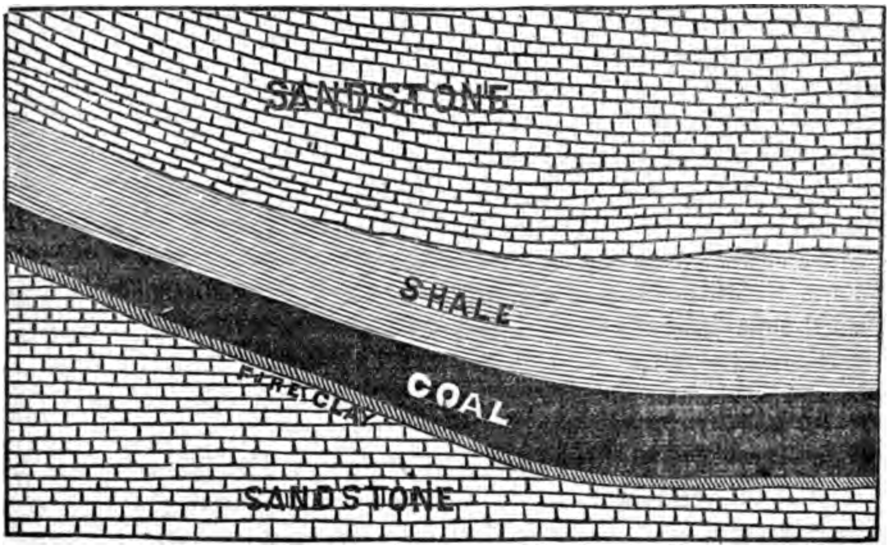
The Salineville mining district of Ohio is situated in Columbiana and Carroll counties (mainly in Columbiana), on both branches of Yellow Creek. There are two seams of coal in course of active development, the Big Vein and the Strip Vein. Both seams are accessible by drift mining, and there is neither shaft nor slope in the district. The Big Vein is from three to six feet in height, where mined, and is lower down in the Coal Measures than the Strip Vein. They are, probably, the equivalents of Nos. 6 and 7 of the Ohio Geological Survey. The most easterly mine on Yellow Creek is the Hays Mine, situated two miles south-east of Salineville, on the line of the Cleveland and Pittsburgh railroad. It is opened on the Big Vein, but the coal is quite thin, scarcely exceeding three and a half feet, caused by the opening being made on the side of an anticlinal arch of the coal strata. The Empire Mine, one-quarter of a mile northwest of Hays's, also opened on the Big Vein, has much thicker coal, varying from four and a half to five and a half feet. This mine is fully fifty feet lower than Hays's, being opened on a swamp or trough. After crossing the swamp, the coal rises to the south-west, nearly west.

There are seven mines in all operated on the Big Vein, namely: the Hays and Empire (already mentioned), Farmers', Hays's (O. and P.), Jones's (O. and P.), Foster's, and Brown's. They extend westward along Yellow Creek for three and a half miles—Brown's wending across the Columbiana county line into Carroll. The mines of the Strip Vein are the Rockville and the Hartford, both on Nancy's Fork of Yellow Creek, one mile north of Salineville. The coal is less than three feet thick in these mines, but it is of a greatly superior quality to the Big Vein. All the other openings of the Strip Vein are located on Yellow Creek, and are the Anderson Mine, the Hussey, the Roberts, the Truesdale, and Brown's. Numerous other openings have been made, but they are not now in course of development. On the south side of Yellow Creek the Strip Vein is subject to numerous horsebacks—rolls in the roof, which come down and cut the seam wholly, or in part, away. These horsebacks are sometimes not more than ten feet apart, and may not be encounter for fifty yards, but they are so numerous, and the cost of cutting the great, as to make it impossible to recover the good coal of the mi profit to the mining adventurers.

On the north side of the creek there are no serious horsebacks encountered, and most of the mines of the Strip Vein are opened on this side. The coal is a little thicker than on Nancy's Fork, exceeding three feet by one or two inches. On the north side the Big Vein is seldom found continuous, and all the openings, with one exception, are on the south side. Here there are no troubles, the coal is continuous, of admirable thickness, averaging five feet, with a firm roof and strong floor. So strong is the gray shale stratum forming the roof of the coal, that rooms forty feet in width are, in many cases, worked up their whole length without a single post being used.

The openings which have been made on the north side of Yellow Creek in the Big Vein show that this is the edge of a basin in which the coal has been deposited. In working forward to the north the coal floor rises, at first very gradually, then more rapidly, and as the coal ascends the hill it grows gradually thinner, losing height mainly from the bottom of the seam. Finally the whole height of seam is lost, the coal thinning to a point. The erosions in the valley of Yellow Creek afford an admirable study for the geologist, and demonstrate that the basin in which the coal is found was not always a basin, but that the trough had been scooped out of an originally level plain anterior to the deposition of the coal vegetation. At the turnpike bridge, which crosses Yellow Creek, near the salt works, in Salineville, the coal and associated rocks are exposed in the bluffs. The coal rises very rapidly, at least one foot in five; the superincumbent strata also rise, conforming to the pitch of the coal, but the strata below the coal are in no wise affected; they lie perfectly horizontal, or maintain their true dip to the south-east, which is a reverse dip to that of the coal at this point. In the cut on the branch railroad to the mines, at the old tunnel, the coal again takes a hill. In a distance of one hundred feet it rises twenty feet; all the strata above the coal pitch as the coal pitches, while the sandstone below the coal maintains its uniformity of level. (See cut on page 165.) In the low place of the coal at this point there is only a foot or two of fire-clay between the sandstone and the coal; as the coal takes the hill the fire-clay increases in thickness, and then a wedge of shale appears, until, in the tunnel, the sandstone and coal are apart twelve feet. The very same conditions were found under the coal at this place as are found under No. 1 in the Mahoning Valley, as also in the Massillon district and in Jackson county, where that seam presents many irregularities of level, the hills being, in some instances, sixty feet high.

Both seams of coal at Salineville are disposed in a succession of hills and hollows, but the undulations of one seam do not always conform to the undulations of the other. On the contrary, the coal beds diverge and converge as many as twenty-five or thirty feet at near intervals. The two mines, the Hayes and Jones, of the Ohio and Pennsylvania Coal Company, opened on the south side of Yellow Creek, are both fully twenty-five feet above the level of that stream, while less than one hundred yards down the creek from the entrance of the lower opening the coal has sunk to the level of the water. Rolls are encountered in the floor of every mine of the district, but they are more numerous and more marked in one mine than another.



SALINEVILLE BIG VEIN.

The three exhausted mines of the Big Vein, on the north side of Yellow Creek, did not yield more than one hundred thousand tons of coal. They each gave out by the coal rising on hills, the seam growing gradually thinner in ascending the hill-sides, until it was no longer possible for the mine owners to remove the coal with profit. Several trial entries were advanced in the thin coal, and the seam continued to decrease until it thinned out to a point. Borings have also been made north of the exhausted area, and revealed only barren ground. Still further north the coal reappears in proper horizon and with its usual thickness, proving that the want in the seam is due to an anticlinal arch of the strata, like the many arches of barren ground encountered in the lower coal of the series, No. 1. This ridge appears to follow the general line of direction of Yellow Creek, and is sinuous, like the course of the creek itself, though the lines of sinuosity are in no wise conformable with the course of the creek.

The southern margin of the trough holding the Big Vein can not be far south of John Hays's mine, below Salineville. This mine, as already stated, is opened on a hill-side, its entrance being fully forty feet higher than the entrance to the Empire Mine, situated one-quarter of a mile north-west. According to the true line of dip of the coal, the Hays Mine ought to be on lower ground than that of the Empire. The coal at Hays's has lost one and a half feet of height in ascending this hill, and as in the case of the northern margin of the basin, this loss comes mainly from the bottom of the seam. The Hays mine has recovered its natural dip to the east and south, nearly east.

A little east of the entrance of the Empire Mine the swamp or lowest place of the coal is met. The entry of this mine dips into the swamp, then crosses it and rises. The line of direction of the swamp is nearly east and west, following the general dip of the coal. The east entries of Farmers' Mine are approaching it, and these entries will continue to dip until they meet the west entries of the Empire Mine, rising from the bottom of the trough. One of the eastern entries of Farmers' Mine has been driven out to day on the edge of Yellow Creek, just below the station at Salineville, and this opening drains the mine of water.

The water-entry of the Farmers' Mine brings the Big Vein down to the level of the creek, and a few rods further down the coal plunges under water altogether. The creek then takes a rapid turn to the north-east, and the coal continues dipping along the course of the stream till the Strip Vein comes down within ten feet of the water, at a point two hundred yards north of the railroad bridge. The creek here changes its course to the south-east, and the coal rises in this direction, which is its true line of dip. Opposite the Empire Mine, the Big Vein is again level free, and at Hays's mine, one-fourth of a mile further south-east, it has risen forty feet above water. At Hays's mine the highest point of the plateau appears to have been passed, as the eastern entries of that mine dip slightly; and still further east, on Pumphrey's land, the coal has again come down to within twelve feet of the level of the creek.

The coal of the Empire and Hays mines has been mistaken by Col. Charles Whittlesey, of Cleveland, for the Strip Vein. He made a survey of this mineral property in 1874, and in his published report says he has no doubt as to its being the Strip Vein. Owing to the rapid changes of level of the Big Vein, and its thinning down in the plateaus to three feet, any geologist might easily fall into this error, which the judging eye of the practical miner, accustomed to such scenes, would at once correct. There is now no longer doubt on this subject. The Ohio and Pennsylvania Coal Company, who are now operating the Empire Mine, propose to open a slope in the Big Vein between the Empire opening and Salineville, and deliver the Empire coal and the coal from the two mines of this Company, opened in the Big Vein in the village of Salineville, through this slope.

A mile or two south-east of the Hays Mine, Dr. Newberry locates one of a series of anticlinals which he finds traversing the coal field. These ridges, he says, are due to the same agencies which caused the upheaval of the Alleghany Mountains, and are the remotest, and consequently the slightest, bindings of the strata which became involved in the upheaval of the Alleghanies. Col. Whittlesey, on the other hand, who has gone over this ground, finds no such arch as Dr. Newberry locates, and calls in question the classification of the seams by Dr. Newberry. Six different seams expose themselves at Hammondsville, seven miles below Salineville, one of which, the Niesly Big Vein, one hundred and seventy feet above the railroad level, Dr. Newberry gives as the equivalent of the Salinevile Big Vein. Its horizon is above that of the Salineville Big Vein, and its location is on the line of dip, south-east, but Dr. Newberry explains this by the folding of the strata forming the anticlinal below Salineville. Whether Dr. Newberry is mistaken or not in his identification of these seams, the conjecture of Col. Whittlesey, that the Niesly seam at Hammondsville may be the upper thin seam at the Empire Mine, is not a correct one; for, as I have shown, the Empire coal is the Salineville Big Vein, and not the Strip Vein, as Col. Whittlesey reports, and hence the thin bed above the Empire Mine is the Strip Vein itself, and not a stratum above it.

In the spring of the present year, during an official visit to the Salineville district, I started on foot down the railroad in company with Sampson Sharp and Jacob Smith, intelligent underground mining superintendents, to follow the Salineville Big Vein along its outcrops, and establish its relation to the Niesly Big Vein at Hammondsville, but had only proceeded two and one-half miles when I received a telegram from Adjutant-General Wikoff, requesting me to come to Massillon and advise with him in reference to the troubles at the mines growing out of the miners' strike. My present opinion—but it is only an opinion given with much diffidence—is, that the Salineville Big Vein and the Hammondsville Big Vein are not equivalents. I think the Salineville Big Vein is a local big vein, due to its lying in a trough of the strata formed anterior to the deposition of the coal vegetation, and that at Hammondsville it is a thin seam, and below the horizon of the Niesly Big Vein. Whether the Big Vein coal is disposed in a long, narrow trough, or in a rounded basin, or whether the arches and hollows which I have described are only local knolls and basins in the coal floor, is of little consequence to the practical miner. The mining developments of the State have already taught the mining adventurer that it is not safe to count on the existence of a workable seam of coal any where in the coal field because such seam is due. Even when the coal has been discovered in good height and purity, there are many troubles of the mine to be encountered which no geologist, nor even a resident mining-engineer, can foretell. Much of the Strip Vein coal is worthless, so far as the immediate practical purposes of the miner are concerned, by reason of such troubles, and the extent of these faults can only be determined by a bold expenditure of money and muscle, under the eye of educated and experienced master miners, which time and necessity will develop. Already some mines have been opened in this faulty coal, but they have been speedily abandoned. Mr. Matthew Brown, the operator of the Brown and Robertsville mines, who has been in this coal region for nearly thirty years, and who is a practical miner from boyhood, states that wherever the Big Vein is found in workable thickness the Strip Vein is worthless, and wherever the Strip Vein is valuable the Big Vein is worthless; and that in all the developments of the region there is no exception to these facts. Brown's mines, the Roberts Strip Vein, and the Brown Big Vein dip in contrary directions, but they are half a mile a part, and on opposite sides of Yellow Creek. The Big Vein coal is less than the usual thickness, being about four feet. At the entrance of the mine there are two seams of coal, the upper bench, ten inches thick, being separated from the main bed by a wedge of shale two feet thick. After passing along the main gallery for one hundred yards or so, this upper bench has thinned to a point, and is never seen again. It is, without doubt, part of the main seam which has become separated by a stratum of shale. This is the only instance of the splitting of the big seam met with in the Salineville region. The coal of this mine rises to the south and east, giving the strata a reverse dip, but this is only another of the numerous undulations of the coal floor which prevail in nearly every mine.

Passing down the railroad from Hays's mine, below Salineville, toward Hammondsville, both the Strip Vein and Big Vein appear to be worthless, for immediate purposes at least. The Big Vein has been opened at a number of places below the Hays Mine, but the coal was found to be too thin to compete with the heavier bed at Salineville.

COSHOCTON.

The mines of Coshocton county are located on both sides of the Pan-Handle Railroad. The most westerly mines are those of Ressler & Co., the most easterly being the Pen Twyn. The Pan-Handle Railroad has heretofore been the western outlet for the coal of this county, but a new road, the Massillon and Coshocton Railroad, now nearly completed, will open another avenue to the markets on Lake Erie. This road will intersect the Tuscarawas Valley Railroad at Byers's Mill, its northern terminus being Coshocton. A new coal company, the Morgan Run Coal and Mining Company, will open up a coal field on Morgan's Run, two and one-half miles south-east of the village of Coshocton. The coal is the equivalent of the seam now in course of extraction by the various coal companies of the region. The mines will be level free, being drained by the valleys of Morgan's Run and Bacon's Run.

The most easterly mine of the series in this county which comes under the requirements of the mining law is opened in a marked swamp or depression in the coal strata. The course of this swamp is a little to the west of south. The mouth of the mine enters the swamp, the main entry following its course. On both sides of this trough the coal rises rapidly. West of the mine's mouth, less than one hundred yards, a new opening was being made in the hill at the time of my visit last June, and the difference of level in this short distance was twenty-five feet.

The Beach Hollow Mine of the Coshocton Coal Company crosses the swamp, and all the workings dip in approaching it. The workings of the Hardscrabble Mine are too far east to touch it, but the Hay Mine enters it at the opening, and here the depression is more marked than at any other point. In working to the right and left of the main entry, the coal rises as high as twenty or twenty-five degrees for some distance from the entry, then the inclination is more gradual, but before the top of the hill has been reached the difference of level is fully fifty feet. The coal in this mine, as in all the others of the district, is thickest in the bottom of this trough, reaching five feet. It gradually loses height in ascending the hill, the thinning of the coal mainly coming from the bottom of the seam. On top of the high ground the coal has become reduced in height to three feet, and in some places to two and one-half feet. After the top of the hill is reached, the bed extends in a level plain, forming a plateau, with numerous slight undulations.

There are three different strata of limestone at Coshocton. One-fourth of a mile east of the Miami Mine, on the McFaden farm, an opening has been made on the upper or black limestone by the Ohio Marble Company. The mine is driven into the hill fifty or sixty feet, the gallery being ten feet wide and eight feet high. The limestone lies in three layers, aggregating five and one-half to six feet in thickness. The lower layer is about eight inches, the middle one ten to twelve inches, and the upper one about four feet. The limestone is black and smooth, and was opened under the impression that it was black marble—an impression still shared by the Ohio Marble Company. The mine is skillfully opened, the foreman being an intelligent practical coal-miner.

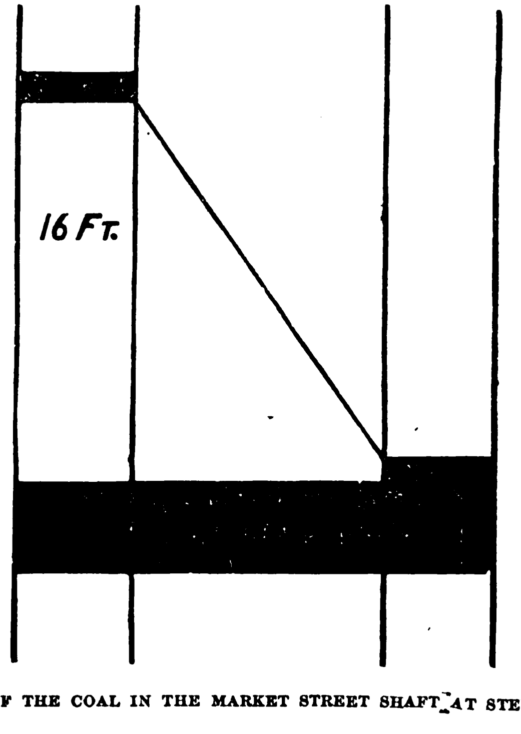
About nine feet below the black limestone a gray limestone appears. A seam of coal is said to sometimes underlie this limestone. Sixty or seventy feet below the black limestone, on a level with the Massillon and Coshocton Railway, a seam of coal is opened, the bed measuring three feet in thickness. The coal was a sandstone roof a foot thick, and this is capped with a stratum of limestone three to four feet in thickness. Westward toward Coshocton the coal thins out, but the limestone is persistent. Above the limestone, four to six feet, a seam of "cannel coal" is exposed. This stratum is also irregular in thickness, and is frequently wanting. The coal is earthy in character, and in burning leaves a heavy white flake in the grate. It is so poor in quality as hardly to be recognized as cannel coal.

At the entrance of Hay's mine, at Hardscrabble, a seam of coal twenty inches thick, lying twelve feet below the main coal, is exposed, and two feet below this coal the top of the black limestone appears in a gray flinty rock, called bastard limestone by the miners. This coal may be the representative of Coal No. 5. If the coal on the level of the Massillon and Coshocton Railroad capped with the blue limestone be the representative of No. 3, and the gray and black limestone fifty to sixty feet higher be the representative of the Putnam Hill or Ferriferous limestone, then this twenty-inch coal is No. 5, and the Coshocton Mine Coal No. 6. As, however, the main coal is capped with a stratum of calcareous shale filled with shells, I have been disposed to regard this seam as No. 4 instead of No. 6, and the calcareous shale overlying the coal as the representative of the Putnam Hill limestone. If the main coal be No. 6, it is much nearer No. 3 than I have ever seen it, the distance between these seams being only about eighty feet, while the usual distance is from one hundred and thirty to one hundred and sixty feet. At Dennison, Coals Nos. 4 and 6 are one hundred and forty to one hundred and fifty feet apart, and No. 5 is about twenty feet below No. 6. The convergence of these coals is, however, no argument against their identity, for, as I have repeatedly shown, the various beds converge and diverge all over the coal area of the State.

STEUBENVILLE.

At Linton, situate at the confluence of Yellow Creek with the Ohio River, two seams of coal are in course of development, known respectively as the Big Vein and the Groff Vein, the latter the upper of the two. They are well up in the hills, and between the Big Vein and the river level five other seams expose themselves. These coals are the equivalent of the beds seen in the hills at Hammondsville and at Irondale. Coming down the river from Linton, the strata dip rapidly, and at the Alikana Shaft, two miles above Stennerville, the Groff Vein is level with low water in the river. The Alikana Shaft, and all the shafts below it to La Grange, are opened on this seam.

The roof of the coal in the Alikana and the Bustard Shafts is a mass of sandstone. In the Furnace Company's Shaft it is shale; in this shaft, as also in the Stony Hollow Shaft, the coal splits in two. In the Stony Hollow Shaft, sunk at the advance workings of the Market Street pit, the two coals are close together, but in passing along the galleries of the mine toward the Market Street Shaft they are seen to converge and diverge, being sometimes ten and twelve feet apart, and sometimes together, forming one seam, with a union so perfect that the line of junction of the two coals can not be pointed out even by the skillful finger of the miner. There are sixteen feet of strata between these seams in the shaft on Market Street.



SPLITTING OF THE COAL IN THE MARKET STREET SHAFT AT STEUBENVILLE.

In the mines further down the river the convergence continues. In the Boreland Shaft, a mile below Market Street, the two seems are twenty-one feet apart in the pit, counting from floor to floor, and at Mingo, three miles below Market Street, they are forty-six feet apart.

The two upper workable coals of Steubenville have been sunk, too, in the Rolling Mill Shaft. They are there forty-eight feet apart from floor to floor. In the shaft at Mingo's, three miles below, a bore-hole was put down in the bottom of the pit, and the first seam met was eighty feet below the working coal, and was only six inches thick, with a cover of sandstone.

Seventeen feet below the bottom of the shaft, a mass of sandstone, reaching down to the six-inch stratum, was the only material met in the bore-hole, except a thin band of ore ten feet above the coal.

This sandstone fills the place of the missing coal, and, doubtless, removed it after deposition in the form of sand passing over the ancient peat bog in currents of water. It is just possible that the six-inch stratum eighty feet below the shaft-coal is the equivalent of the lower coal in the Rolling Mill Shaft, which is there forty-eight feet below the upper coal. The divergence of thirty-two feet in a distance of two miles is not as great as the divergence of sixteen feet in a few hundred yards, as shown in the splitting of the seam in the Market Street Mines.

Besides the hole drilled in the bottom of the Mingo Shaft, two other holes were drilled by J. C. Cram, Esq., superintendent of the mines, one of them twelve hundred feet north-west of the shaft, and the other thirty-two hundred and fifty feet north eighteen degrees west of the shaft, and neither of them struck the lower coal of the Rolling Mill pit. All three holes, however, were sunk still lower, and at a depth of one hundred and thirty feet below the horizon of the coal a seam three feet nine inches thick was struck, there being only two feet of difference in the level of the coal in the three holes. Mr. Cram calls this the Roger Vein of Yellow Creek, Dr. Newberry's No. 5.

The thin coal forty-six feet above the shaft coal at Mingo is, in my judgment, the offshoot at the Stony Hollow and Furnace Company's mines. A thin bed is passed through at both the La Grange and Rush Run Shafts, and is found continuing to diverge from the main seam. The La Grange Shaft is two hundred and sixty-one feet deep, and passes through four different coal stratas, though I think the second and third beds, which are only two feet apart, are one seam split in two by a wedge of shale. This seam, which is thirty feet above the main bed in the bottom of the pit, counting from floor to floor, I regard as the equivalent of the Mingo Shaft coal and of the shafts above Mingo at Steubenville, and the coal in the bottom of the shaft, as the equivalent of the four-foot coal forty-eight feet below the working coal in the Rolling Mill Shaft. The first coal met in the La Grange Shaft is thirteen inches thick, and is one hundred and fifty-one feet from the top of the shaft; the second (counting the two strata so close together one bed) is twenty-two inches, exclusive of slate, and is two hundred and forty feet from the top, this being the drift coal of Mingo, the Rolling Mill Shaft, etc. Of course there is no absolute certainty in this conclusion, and it is proper to add that it is not shared by some of the mine owners and mine superintendents of Steubenville, for whose opinions I have the very highest regard.

The Rush Run Shaft is two hundred and fifty-eight feet deep, and passes through but two seams of coal. The first stratum in descending order is one hundred and twenty-nine feet from the top of the shaft, and the same distance from the bottom. The seam is only six inches thick. It is undoubtedly the equivalent of the upper coal of the La Grange Shaft, showing a divergence of these beds of nineteen feet. At the bottom of the Rush Run Shaft the coal is nine feet thick, three feet nine inches thicker than the La Grange coal. In the Rush Run Shaft there appears no trace whatever of the two coals found in the La Grange Shaft, twenty-three and twenty-five feet above the main coal, and the probability is that they have come down in the main coal at Rush Run, the three forming one homogeneous mass there. This would show a convergence of the seams of twenty-three feet, being four feet more than the divergence of the upper coals. If this is not the case, the middle coals at La Grange Shaft have thinned out altogether at Rush Run, while the lower coal at Rush Run has increased three feet nine inches in thicknes since leaving La Grange.

The Rush Run coal does not, however, retain this extra height, but thins down in the mine to seven feet or less.

There is a bed of coal in the barren measures eighty feet above the level of the Pan-Handle Railroad at Boreland's Shaft. This is a very persistent seam, its horizon being about two hundred and seventy feet above the Steubenville Shaft coal; it, however, waves up and down like the seams below it. At Mingo it is seen on the south side of the shaft in the ravine, and not more than twenty or thirty feet above the top of the pit.

From Steubenville to Bellair the dip of the strata is very marked in a generally southerly direction. At Steubenville the Pittsburgh coal is five hundred feet above the bed of the Ohio River, and at Rochenhauser's Slope, two miles below Bellair, it has dipped to the water's edge, the distance being twenty-eight miles by the river. The coal is opened every few hundred yards along the river, and at every mine in descending from Steubenville it comes nearer and nearer the river. Only two mines are level-free below Bellair—the upper and lower mines of the Belmont Coal Works.

BELLAIR TO BARNESVILLE.

The hills fronting the Ohio River, between Bellair and Pipe Creek, are six hundred feet in perpendicular height, and hold all the coals of the upper Coal Measures, nine different seams, which rise to two feet of thickness. These coals have been designated No. 8, No. 8*a*, No. 8*b*, No. 8*c*, No. 9, No. 10, No. 11, No. 12, and No. 13 in the Geological Reports. No. 8, the lowest of the series, is the equivalent of the Pittsburgh and the Pomeroy coals. It is level-free at Bellair, but plunges under the Ohio, two miles below that village. From twenty-eight to thirty-feet above the Pittsburgh Coal, counting from the floor of the seam, No. 8*a* appears in a coal varying from six inches to two and a half feet in thickness. Twenty to twenty-three feet above No. 8*a* No. 8*b* appears in a seam of very irregular thickness, sometimes rising to four feet and sometimes receding to one foot. Twenty-five to thirty feet above No. 8*b* No. 8*c* comes in, being a four-foot coal, and is known as the upper Barnesville seam. No. 9 is from one hundred and ten to one hundred and twehty feet above No. 8*c*, and No. 10 is about forty feet above No. 9. The distances between No. 8*c* and No. 9, and between No. 9 and No. 10, are, however, only estimated distances, as, there being no engineer's tools at the coal mines, I could not make accurate levels, and never trust the readings of an aneroid barometer. Coal No. 11 is located about one hundred feet above No. 10 in the Geological Reports. Five of the above seven seams of coal extend all the way from Bellair to Barnesville, on the line of the Baltimore and Ohio Railroad, No. 8*a* thinning out at Glencoe, and No. 11 cropping out on the high hills west of Burr's Station. Coals No. 12 and No. 13 do not come down to the cuts on the railroad, and so have not been traced. No. 8, the Pittsburgh seam, has been mined for many years around Bellair, both on the Ohio and the railroad. In Kidd's Mine, one-half mile east of Neff's Siding, on the railroad, the coal is forty-eight feet above the level of the railroad. This opening was made on the eastern side of an anticlinal arch of the strata, and at the new mine, one hundred and fifty yards west of the old one, the coal is only thirty feet above the railroad level. One hundred and fifty yards west of the new mine the swamp or synclinal is reached, and here the coal comes down to within sixteen feet of the track. Thirty feet above the coal at this point No. 8*a* is seen. The coal is less than two feet thick, and is heavy and earthy in character. Two hundred and fifty yards west of the swamp, in a cut on the Bellair and St. Clairsville Railroad, Coal No. 8 is forty-four feet above the level of the road, having risen twenty-eight feet in this distance on the opposite side of the anticlinal from where the mines are opened.

In both the old and new mines a slip-dike is crossed, which throws the coal down seven feet in the new mine, and three feet in the old mine. The line of direction of the dike is north-east, and it is again met in Brittonstien's Mine, four miles north-east of Kidd's It crosses the Ohio River north of Wheeling.

Three hundred feet west of Kidd's Mine the coal is nearly fifty feet above the railroad, and the underlying strata is composed of gray shale. This appears to be the summit of the anticlinal, for in the next cut, one hundred and fifty yards west of the strata, the coal is down within twenty feet of the road. Eleven feet below the coal-bed at this point a seam of coal a foot thick is exposed, resting on a bed of fire-clay. In King's Cut, three hundred yards east of Franklin Station, the Pittsburgh coal is within nine feet of the railroad, and the track in Franklin tunnel, west of the station, rests on the bottom of the seam. In this tunnel all the coal and overlying strata up to No. 8*a* are cut away, that bed of coal forming the roof of the tunnel. At Military Cut, about midway between Franklin Station and Glencoe, the Pittsburgh coal is buried three feet beneath the bed of the railroad, and No. 8*a* is seen resting on a stratum of fire-clay, the fire-clay in turn resting on a bed of limestone sixteen feet thick. No. 8*a* has thinned to four inches, but the limestone on which it rests and the overlying soapstone are well marked. In Welsh's Cut, two hundred yards west of Military Cut, No. 8*a* is still in place, but thin.

Three-quarters of a mile east of Glencoe the Pittsburgh coal is buried ten to twelve feet under the railroad track, and is half buried in McMahon Creek. This is the last seen of No. 8 until it is met in the shaft of Dawson & Stanton at Barnesville. No. 8*a*, still ten or twelve feet above the railroad, has thinned out, its place being taken with gray shale; over this shale the soapstone, which formed the roof of the coal, is present, and the soapstone is capped with the fine, smooth-faced, gray limestone seen in every slope in the Bellair district, and in every cut between Bellair and Glencoe.

In the deep cut at Glencoe the horizon of No. 8*a* is twenty-four feet below the railroad, and the overlying limestone is also buried. Seven to nine feet above the track No. 8*b* is present, but the seam is very thin, with an irregular roof and floor. Twenty-five feet above this coal No. 8*c* appears in a four-foot coal, resting on a fire-clay floor, and having a soapstone cover four feet thick. Above the soapstone there is a stratum of cement limestone ten feet thick, this in turn covered with fourteen feet of limestone, and the limestone by a second stratum of cement four feet thick. These cement strata are very persistent, holding a general thickness, and are seen in the cuts of the railroad after No. 8*c* is buried.

One quarter of a mile west of Glencoe Cut No. 8*b* plunges under the railroad, and at the railroad bridge is within five feet of the edge of McMahon's Creek. In Glencoe tunnel No. 8*c* is level with the railroad on the east end of the tunnel, but rises four feet above the track in passing through the west end. For nearly half a mile the coal holds its own with the road, refusing to go down, but in McGinnes's Cut, one mile east of Warnock's Station, it is forced under the track and down to the creek itself. This cut is sixty-six feet deep, but shows no coal in place, though in the higher bluffs north of the cut Coal No. 9 appears.. The vertical distance between No. 8*c* and No. 9 is about one hundred and ten feet. One quarter of a mile west of this point No. 8*c* makes an effort to rise above water, and the top of the seam is seen to bare itself in the creek.

From Neff's Siding to this point is seven miles, and No. 8*c*, there one hundred and twenty feet above McMahon's Creek, is here buried under its bed. The Pittsburgh coal is now eighty to eighty-five feet below the bed of McMahon's Creek.

At Warnock's Station No. 9 is opened and mined for the first time along the line of the railroad. The coal is three and a half feet thick, has a slate roof eight inches thick, then a stratum of soapstone of three feet, then a massive sandstone. Forty feet above No. 9 No. 10 is said to exist, and is known as the three-foot coal. At Warnock's Water-station, one mile west of the village, No. 9 is seen in Ryan's Cut, sixty feet above the level of the railroad. The seam is thin, and is capped with sandstone, and this explains its reduced height. Two and a half miles west of Warnock village No. 9 comes down to the railroad level, thence it bravely holds its own with the railroad to Lewis Station, sometimes rising above and sometimes falling below the railroad. At Lewis Station it is buried two feet under the track, and No. 10 is seen in the cut thirty-six feet above the railroad. At Belmont, three miles west of Lewis's Mill, No. 10 is also lost under the railroad; some of the old openings, which extended under the track, being unskillfully mined, once caved in and let down the railroad.

Half a mile north of Belmont a shaft is now in progress of sinking, on the farm of George Crossland, to reach Coal No. 8*c*, known there as the four-foot or upper Barnesville coal. Before the shaft was started a level was made to the mines of Badgersburg, two miles north-west of Belmont, and the engineer calculated that coal would be struck in the Belmont Shaft at the depth of forty feet from the surface, but in this calculation no allowance was made for the dip of the strata, and the coal will undoubtedly be much deeper. This shaft is located not more than thirty feet below the horizon of No. 9, and as these coals are usually about one hundred and ten feet apart it will be to little purpose to hope to reach coal inside of eighty or ninety feet.

The mines at Badgersburgh, situate on the head-waters of Stillwater Creek, are opened on No. 8*c*, and consist of eight or nine small banks, from which the coal is drawn for the supply of the neighboring farmers. The coal bears a striking resemblance to the upper Barnesville seam, and is beyond any question of dispute its equivalent.

Passing along the railroad from Belmont toward Barnesville, we find Coal No. 10, buried under the track at Belmont, exposing itself in several places in the ravines below the railroad embankments on the head-waters of Capitina Creek. Ten feet above the railroad, in Norris's Cut, a stratum of black shale, resting on a bed of fire-clay, is seen. This shale holds its own with the railroad for nearly two miles, being exposed in every cut. In the west end of Hoffey's Cut part of the shale is replaced by a stratum of coal six inches thick. In this cut the strata so long keeping pace with the grade of the railroad begins to dip, and the six-inch seam of coal is lost under the track. The horizon of this coal is about forty-five feet above Coal No. 10.

In Turn-Table and in Tunnel Hill cuts, Coal No. 11 is exposed twenty feet above the level of the railroad, and about forty feet above the intercalated coal seen in the Hoffey Cut.

The hill pierced by Tunnel Hill Cut is the highest arch in Belmont county, and Coal No. 11 crops out on the west side of the ridge. The railroad, which rises all the way from the Ohio to Tunnel Hill, now begins to descend, though not continuously, for there are still several up-grades the before reaching Barnesville. A mile west of Burton's, in Hoyle's Cut, thin stratum of coal first seen on the west end of Hoffey's Cut reappears eight feet above the railroad track, and is seen in every cut a few feet above the railroad until we reach within a mile of Barnesville, where the descent of the road throws it upward. From Tunnel Hill to near Barnesville the road runs along the high lands which divide the waters flowing eastward into the Ohio River, and those flowing westward into Wills Creek. The cuts in the road are all shallow, and the coal is found only on the summits of these ridges, leaping from hill to hill, and frequently having no roof cover whatever. The railroad from Burton's to Barnesville runs in a general south-west line along the line of level of the coal strata.

A mile east of Barnesville the road begins to descend at the rate of forty feet to the mile, and this coal is left on the high bluffs above the railroad. No. 10 emerges above ground on the railroad three hundred yards east of Rocky Cut; in that cut, situate east of the tunnel, it is twenty-two feet above the track. At the tunnel it is about the same height above the railroad, and is the arch vein of Prof. Andrews's report. At Rocky Cut No. 9 is twenty feet below the railroad, and forty-two feet below No 10. The shaft of Messrs. Dawson and Stanton is sunk in the ravine directly below Rocky Cut, and is one hundred and seventy-two feet deep, to the bottom of the Pittsburgh coal. The following section, furnished by Mr. Dawson, beginning with the highest coal on the top of Wisener's Hill to the bottom of the shaft, shows the strata:

		FEET.
1.	Highest seam on top of hill	1.50
2.	To Coal No. 10	47.35
3.	Thickness of coal	3
4.	To Coal No. 9	42.50
5.	Thickness of coal	3
6.	To top of coal shaft	36.25
7.	(Shaft) clay	4
8.	Limestone	2
9.	Brown shale	5.50
10.	Thin layers of limestone and cement	37.50
11.	Soapstone	3
12.	Blue clay (soapstone)	1.50
13.	Soapstone	3
14.	Sandstone	5
15.	Sandy shale	4
16.	Roof coal	0.80
17.	Soapstone	2
18.	Coal No. 8*c*	5
19.	Shaly limestone	9
20.	Hard sandstone	2
21.	Soapstone	4.50
22.	Coal No. 8*b*	2
23.	Limestone	9.50
24.	Parker cement	4
25.	Soapstone	26
26.	Sandstone	35
27.	Shale	1
28.	Pittsburgh coal	4.50
	Total	303.5

The place of No. 8*a* in the above section is about thirty-two feet above the floor of the Pittsburgh coal in the bottom of the shaft. As this place is filled with a stratum of sandstone which reaches down to the Pittsburgh coal itself, No. 8*a*, if it ever existed, was subsequently removed by denudation.

The foregoing section could be duplicated at any point betwen Bellair and Barnesville, with, of course, the varying strata, which is found to change often even in a few rods. Coal No. 10*a*, on top of Wisener's Hill, has also no place on the Ohio River, it being beyond doubt a seam which begins west of Belmont. On the Ohio River, at Pipe Creek mines, No. 9 was not exposed, but No. 10 is opened, and is a seam three feet thick in a homogeneous mass, and is known as the block coal. No. 9 is, however, seen at the Pittsburgh works of Messrs. Rockinghauser and Sterritt, a few miles up the river.

On page 160, Vol. 2, Geology, Prof. Newberry says:

> "In the report of Belmont county by Prof. J. J. Stevenson, a detailed description will be found of our upper coals, and some facts of special interest are there reported in regard to the Pittsburgh seam. He apparently demonstrates that while in western Belmont county it is a single seam, on the Ohio at Bellair it is represented by four coals, three of which occupy the space between Coal No. 8 and Coal No. 9, this interval having been increased from fifty feet at Barnesville to one hundred and fifty feet at Bellair. * * * * It is Prof. Stevenson's opinion that Coals Nos. 8*a*, 8*b*, and 8*c*, the three seams above the Pittsburgh, in the Bellair section, are offshoots from Coal No. 8, and that they all run together."

This is all wrong. So far from there being any coalescing of the seams in the Barnesville district, the reverse is the fact, for Coals No. 8 and No. 8*c*, eighty feet apart at Bellair, are ninety-seven feet apart in the Barnesville shaft. Even if No. 8*a*, No. 8*b*, and No. 8*c* had coalesced with No. 8 at Barnesville, the first seam met in the shaft in ascending order is seventy-nine feet, and not fifty feet, above the Pittsburgh coal. Moreover, Coal No. 9, instead of being only one hundred and fifty feet above the Pittsburgh coal at Bellair, is one hundred and ninety feet above it, and is two hundred and two feet above it at Barnesville.

On page 545, same volume, Prof. Andrews says:

> "My associates on the Survey in the First Geological District have classified the coals on the Ohio River in this (Belmont) county in the descending order as follows: Coal No. 10, No. 9, No. 8*c*, No. 8*b*, No. 8*a*, No. 8 (Bellair, or lower Barnesville). We trace the same seams in the same order through all the high lands of the Barnesville region. We could find no coalescing in going from the Ohio River west, by which 8*c*, 8*b*, 8*a*, and 9 unite with 8. Mr. Bundy and myself have found all these on the west side of the Barnesville ridge. For example, 8*a* is seen faintly in a railroad cut west of Barnesville, on the turnpike north of Barnesville, on the turnpike between Flushing and Rock Hill, on Belmont Ridge, in Flushing township, and at other points. It even extends through several counties. No. 8*b* is distinctly seen at all the above-named localities. No. 8*c* is the upper Barnesville seam."

This is an intelligent statement of the main facts of the coal strata between Barnesville and Bellair.

CAMBRIDGE AND POMEROY.

The Cambridge coal appears to occupy a limited area as a workable seam. One mile east of the Norris Shaft, on the line of the Baltimore and Ohio Railroad, on the McCreery farm, a shaft was sunk three years ago to the coal level, and no coal was found. Seven years ago, also, another shaft, sunk at Campbell's Station, two miles east of the McCreery farm, failed to strike coal. These openings, which were made at considerable expense, were started without any previous search for the coal by boring, a manner of doing business which no practical mining engineer will recommend. All of our coal seams, with the exception of No. 6 and the Pittsburgh bed, No. 8, are subject to sudden thinning out.

West of the Guernsey Mine the coal has been opened in a number of places on both sides of the railroad, and has invariably been found too thin for working, and this, too, where the regular shale roof caps the coal. In these openings the seam is of varying thickness, sometimes rising to four feet, and then thinning down to one and two feet within the space of a few yards. In opening these mines the coal was always found thickest at the outcrop. Approaching Cambridge from these mines the coal becomes thin, and appears to be wanting in many places, and where present, to be capped with a sandstone roof. In the railroad tunnel west of the village the coal is seen thirteen or fourteen feet above the level of the railroad; it is there covered with a shale roof, but the seam is not more than fifteen or sixteen inches thick.

Two thin seams of coal lie above the Cambridge thick coal at the Scott and other mines of the district. They are both present at the Norris Shaft. The lower of the two is about one foot thick, and is sixty-five feet above the shaft coal in the air-shaft, and the upper coal is thirty feet above this seam, and is seen cropping out in the ravine on which the air-shaft is sunk. This upper bed has been opened at several points on the opposite side of Leatherwood Creek to the east of the Norris Shaft. It is there a block coal of varying thickness, with a shale parting running through it. The coal appears to be deposited on a very uneven floor—in hills and hollows—and attains a height of two and one-half feet in the low ground or trough, losing thickness in rising on the hill-sides, Still further east, at Anderson's, six and one-half miles from Cambridge, it is found from two to three feet thick, but still occupies an irregular floor, rising and thinning out quite rapidly. These two thin beds of coal appear to thin out on coming west. Only the merest trace of them is seen in the cut of the tunnel to the west of Cambridge. The fire-clay floors of both seams are present, each in its proper horizon; but there is only a trace of shaly coal resting on the floor.

All the mines opened on the main Cambridge coal show a coal floor somewhat wavy and uneven. From the Norris Shaft to Scott's Mine there is a rise of twelve feet in a distance of one mile. From Scott's to Fordyce's, another mile westward, the difference of level is about the same as from Norris's to Scott's; but from Fordyce's to Robins's, only one-third of a mile west, the rise is at least twenty-five feet. At the village of Cambridge, three miles west of Robins's, the coal is lower than at Robins's, and is still lower at the tunnel than at Cambridge. This dip from Robins's to the tunnel is a reverse dip to the true line of dip, as the direction is north-west. In Scott's Mine the main entry, opened on the face of the coal, dips to the south, until it has sunk seventeen feet, and then commences rising, while in the Fordyce Mine the coal rises very rapidly to the south for six hundred feet. The Robins Mine also rises to the south on the main entry. In the lowest place in Scott's and the highest place in Fordyce's there can not be less than fifty-five or sixty feet of difference of level in a distance of one mile. Inequalities of level are also encountered in the Nicholson mines, but they are not as marked as in Robins's and Fordyce's.

The ridges and hollows of the various seams are not conformable to each other. The upper thin seam at the Norris air-shaft, the equivalent of the Anderson block coal, pitches in many places at an angle of twenty degrees, the coal rapidly thinning out on the steep hill-side. The distance between the first coal above the main seam, as already stated, is sixty-five feet in the Norris air-shaft, while at the hoisting-shaft it is only fifty-two feet, a convergence of thirteen feet in a distance of two hundred yards.

The roof of the mines in this district is often studded with the casts of trees (called coal-pipes, or bell-mounds, by the miners), standing erect as they grew. These casts do not shoot up in the shale more than eight inches or a foot until they suddenly stop short, as if the tree had rotted and fallen, and the impressions of the prostrate forms of the trunks are often stretched full length as they fell.

The course of the Marietta, Pittsburgh and Cleveland Railroad, from Cambridge to Marietta, is nearly south, and the strata dip more to the south than east. Two miles below Cambridge, on Wills Creek, the Nicholson mines, opened on the main Cambridge seam, are twenty-five to thirty feet above the level of the creek; but at Bysville, three miles further south, the coal is down to the water-line At Point Pleasant, three miles below Bysville, the upper of the two thin coals overlying the Cambridge coal is opened. This seam is here thirty inches in thickness, and is about thirty-five or forty feet above the level of Wills Creek. The roof of the coal is a calcareous shale, filled with fossil shells.

In passing southward along the railroad a long stretch of the barren measures is traversed. The Pittsburgh seam is first opened in the high lands in the southern part of Noble county. The coal is mined at Dexter City and at Macksburg, and resembles the Bellair coal in character and thickness. The seam is double; the upper three feet, which is very impure, is separated from the lower or main bed by a stratum of fire-clay from fifteen inches to three feet thick. The lower bench is five to six feet thick, of good quality, and easily mined.

The Pomeroy coal ranges from four and a half to five and a half feet in thickness, and is a homogeneous mass, except in the Cheshire Mine, where an upper stratum of coal one to two feet in height appears, forming a double seam, the intercalated shale being two feet thick. The immediate cover of the coal is generally a light gray shale, ranging from a mere trace to twenty feet thick. Above this is a massive sandstone. Frequently this rock comes down on the coal forming the roof, and it sometimes also cuts part of the seam out. Wherever a rock roof appears the coal is of inferior quality, being coarser in nature and more largely impregnated with sulphur. In the coal floor there are many ridges, which rise up in the form of a saddle or horseback, and cut out the lower part of the coal. These faults, resembling a horse's back, have received that name from the miners, a term now very generally applied by Americans to all the troubles encountered in coal seams. Sometimes these horsebacks will not extend more than a few yards in length, and again they will run for several hundred yards. Their line of direction is south-east, following the dip of the coal. They seldom if ever cut out the whole of the seam, are never more than a yard in thickness, and are broadest at the base.

The dip of the coal strata is south-east, say south seventy-five degrees east, at the rate of twenty-five or thirty feet to the mile. The coal floor has numerous undulations, but none of them are as marked as those met in the mines opened in the lower Coal Measures. In the Pamunky bank of the Pomeroy Coal Company one of the entries running east dipped twenty-four feet in twenty-four hundred feet. This entry sunk into a swamp or trough, and rose after crossing it.

The shale roof of the mines of this region is remarkable for the numerous and beautiful impressions of leaves, stems of trees, and ferns, which cross each other in luxuriant profusion. Some of them are entombed in the sandstone, even where this material forms the immediate cover of the coal. It is highly probable that the sandstone roof was not the first roof the coal received. The muddy sediment now forming gray shale, with its numerous and well-marked flora, was doubtless equally spread over the whole of the coal, and was subsequently washed away by water, and the sand afterward settled in the place of the removed material.

The strata covering the Pomeroy seam of coal is from two hundred and fifty to three hundred feet thick, and they appear to contain no workable beds of coal, being composed mostly of massive beds of sandstone, with thin beds of gray shale interstratified.

Numerous holes have been bored in the neighborhood of Pomeroy for salt, some of them reaching a thousand feet in depth, and two minable seams of coal are reported as having been passed through, but no journal appears to have been kept of the material encountered. As the Pomeroy coal is the equivalent of the Pittsburgh seam, there should be ten workable beds if all the coals were in place below it. The lower coals, however, are subject to frequent and extended wants by thinning out. Nos. 4 and 6 are the most continuous of the series. The upper of the two coals reported in the bore-holes is said to be about four hundred feet below the level of the river. This is probably No. 6, the strata above it to the Pomeroy coal being composed of the barren measures.

EXTENT AND CLASSIFICATION OF COALS.

Wherever any of the coal seams are due they extend, with occasional wants, the result of various causes, over the whole coal area. There is a play of variation between the different beds ranging from one to seventy feet or more, and sometimes a bed is found to split up into two or more parts. This is especially true of Coal No. 4, the seam underlying the Putnam Hill or Ferriferous limestone. Occasionally also some of the thin seams lying between No. 1 and No. 3 enlarge to minable height. The blue limestone so often overlying No. 3 is generally found to range from one hundred and twenty to one hundred and sixty feet above the horizon of No. 1, the Putnam Hill or Ferriferous limestone is from one hundred and ninety to two hundred and twenty-five feet above No. 1, and the Nelsonville coal is from two hundred and eighty to three hundred and twenty feet above it. When the true horizon of the Ferriferous limestone is understood, all the coals of the lower Coal Measures will be seen to fit in place in every mining district of the State. Thus the Nelsonville and Sheridan coals are equivalent strata, and the Bayley's Run and Hatcher seams are also equivalents, these latter being the representatives of the Salineville Strip Vein and of the Steubenville Shaft coal. By this classification there is harmony and order.

Respectfully submitted,

Andrew Roy,
State Mine Inspector

LIST OF MINES, TOGETHER WITH NAMES OF OPERATORS, ETC.

ATHENS COUNTY.

Name of Mine.	Kind of mine.	Name of Coal Company.	P. O. Address.
Lick Run	Drift	I. W. Scott	Nelsonville.
Laurel Hill	“	Laurel Hill Coal Co	Bretland.
Section 29	“	W. B. Brooks & Son	Nelsonville.
Harper's*	“	Harper Brothers	Nelsonville.
Coöperative	“	Nelsonville Mining Co	Nelsonville.
Poston's	“	Poston Brothers	Nelsonville.
Longstreth's	“	T. Longstreth	Nelsonville.
Star	“	Star Mining Co	Nelsonville.
Doanville*	“	N. Y. & O. Coal Co	Nelsonville.
Floodwood	“	B. B. Sheffield & Bro	Floodwood.
Hamley's Run	Shaft	G. F. Gould	Athens.
Salina	“	“	Athens.
Chauncey	“		
Big Run*	“	Federal Creek Coal Co	Big Run.
Carbondale	Drift	Carbondale Coal Co	Mineral City.
King's	“	King Brothers	King's Switch.

BELMONT COUNTY.

Barnesville	Shaft		
Steward's	Drift	Stewart & Mehan	Stewardsville.
Kidd's	“	Kidd Brothers	Shields.
Rainey's	“	W. J. Rainey & Co	Cleveland.
Etna	“	Etna Iron and Nail Co	Martin's Ferry.
Helling's	“	Henry Helling	Martin's Ferry.
Ohio City	“	Ohio City Iron and Nail Co	Martin's Ferry.
Belmont Works No. 1	“	Heatherington Brothers	Bellair.
Belmont Works No. 2	“	“ “	Bellair.
Pittsburgh Works	Slope	Rochenhouser & Sterrett	Bellair.
Empire	“	Thomas Corcoran	Shawnee.
Weegee	“	P. Shafar & Co	Weegee.
Union Works	“	Union Coal Co	Moundsv'e, W. Va.
Pipe Creek	“	Pipe Creek Coal and Iron Co	Dilley's Bottom.
Barnard's	Drift	W. G. Barnard	Bellair.
Morgan's	“	E. G. Morgan	Bellair.

CARROLL COUNTY.

Robertsville No. 1	Drift	Cleveland Iron Co	Salineville.
Robertsville No. 2	“	“ “	Salineville.
Brown's Strip Vein*	“	Matthew Brown	Salineville.
Brown's Big Vein*	“	“	Salineville.
Dutchen & Davis	“	Dutchen & Davis	Salineville.
Tunnell Hill	Shaft	I. C. Card	Cleveland.
Welsh Mines	Slope	McDowell & Pratt	Mineral City.

COLUMBIANA COUNTY.

Washingtonville No. 1	Drift	Cherry Valley Iron Co	Leetonia.
Washingtonville No. 2	“	“ “	Leetonia.
Leetonia Slope	Slope	“ “	Leetonia.
Grafton	Shaft	Grafton Iron and Coal Co	Leetonia.
Empire	Drift	John Hayes & Co	Salineville.
Hayes	“	“ “	Salineville.
Farmer's	“	Jas. Farmer	Salineville.

COLUMBIANA COUNTY—Continued.

Name of Mine.	Kind of mine.	Name of Coal Company.	P. O. Address.
Hartford	Drift	O. & P. Coal Co	Salineville.
Rockville	"	" "	Salineville.
O. and P	"	" "	Salineville.
Granage & Anderson	"	Manufacturers' Coal Co	Salineville.
Foster	"	Harding & Sharp	Salineville.
Hussey Hollow	"	O. & P. Coal Co	Salineville.
Truesdale	"	Truesdale Coal Co	Salineville.
Robins'	"	New Lisbon Coal Co	New Lisbon.
Foster Mine	"	Shields Coal Co	Teegarden.
Rose Mine	"	Thomson & Coleman	Teegarden.
State Line	"	State Line Coal Co	East Palestine.
Prospect Mines	"	Prospect Coal Co	East Palestine.
O. and P	"	O. and P. Coal Co	Salineville.

COSHOCTON COUNTY.

Union	Drift	Union Coal and Mining Co	Coshocton.
Blaen Nant	"	Edward Prosser	Coshocton.
Rock Run	"	Rock Run Coal Co	Coshocton.
Summit	"	Franklin and Coalport Coal Co	Coshocton.
Coshocton	"	Coshocton Coal Co	Coshocton.
Diamond	"	Diamond Coal Co	Coshocton.
Cunesville	"	Ressler & Co	Newark.
Pen Twyn	"	Pen Twyin Coal Co	Coshocton.
Home	"	Home Coal Co	Coshocton.

GUERNSEY COUNTY.

Scott's	Drift	Scott Coal and Salt Works Co	Cambridge.
Cambridge	"	Cambridge Coal and Mining Co	Cambridge.
Central	Shaft	Wm. Norris	Cambridge.
Nicholson	Drift	Ohio Coal Co	Marietta.
Guernsey	"	Guernsey Mining Co	Cambridge.

GALLIA COUNTY.

Leadington	Drift	Leadington Coal Co	Cheshire.
Cheshire	"	Cheshire Coal Works Co	Cheshire.

HOCKING COUNTY.

Section 19	Drift	W. B. Brooks & Son	Nelsonville.
Hayden's	"	Peter Hayden	Haydenville.
Gore*	"	Straitsville and Monday Creek Coal Mining Co	Gore.

HOLMES COUNTY.

Hardy *	Drift	Hardy Coal Co	Millersburgh.
Bowens	"	Bowen Bros	Millersburgh.

HARRISON COUNTY.

Philadelphia	Drift	Philadelphia Coal Mining Co	Station 15.

JEFFERSON COUNTY.

Name of Mine.	Kind of Mine.	Name of Coal Company.	P. O. Address.
Market Street	Shaft	Steubenville Coal Mining Co	Steubenville.
Stony Hollow	"	" " " "	Steubenville.
Gravel	"	Steubenville Furnace and Coal Co	Steubenville.
Everick's	"	Ohio and Pennsylvania Coal Co	Steubenville.
Boreland's	"	Cincinnati Coal and Coke Co	Steubenville.
Rolling Mill	"	Spaulding, Woodward & Co	Steubenville.
Mingo	"	Mingo Iron Works Co	Mingo.
La Grange	"	La Grange Coal Co	Phillipsburg.
Rush Ran	"	Peck & Ramsey	Rush Ran.
Bustard's	"	Steubenville Coal and Coke Co	Steubenville.
Alikana	"	Bell & Co	Steubenville.
Cable *	"		
Irondale No. 1 *	Drift	Morgan Iron Co	Irondale.
Irondale No. 2 *	"	" "	Irondale.
Irondale No. 3 *	"	" "	Irondale.
Hammondsville *	"	Hammondsville Coal and Coke Co	Hammondsville.
Strip Vein	Shaft	Wallace & Sons	Hammondsville.
Diamond	Drift	" "	Hammondsville.
Strip Vein	"	Morgan Iron Co	Irondale.
Big Vein	"	" "	Irondale.

JACKSON COUNTY.

Wellston	Shaft	Wellston Coal and Iron Co	Wellston.
Milton	"	Milton Furnace and Coal Co	Wellston.
Star	"	Star Furnace Co	Jackson.
Tropic	"	Tropic Furnace Co	Jackson.
Orange	"	Orange Iron Co	Jackson.
Globe	Slope	Globe Iron Co	Jackson.
Huron	Shaft	Huron Iron Co	Jackson.
Erie	"	Erie Iron Co	Jackson.
Jackson Hill	Drift	Price Brothers	Jackson.
Petrea	"	Petrea Coal Co	Jackson.
Jackson Hill	"	Thomas M. Kitrick	Jackson.

LAWRENCE COUNTY.

Sheridan	Drift	Sheridan Coal and Iron Co	Sheridan.
Hanging Rock	"	Means, Kyle & Co	Ironton.
Bellford	"	Norton Bros. & Co	Ironton.
Old Mill	"	Iron and Steel Co	Ironton.
Lawrence	"	Lawrence Iron Works Co	Ironton.

MEDINA COUNTY.

Wadsworth	Slope	Wadsworth Coal Co	Akron.
Diamond	"	Humphrey & Coleman	Akron.

MAHONING COUNTY.

Foster	Shaft	Foster Coal Co.	Youngstown.
Osburn	"	Andrews Brothers	Youngstown.
Kyle	"	Kyle Coal Co	Youngstown
Wick and Wells †	"	Wick and Wells	Youngstown.
Austin	"	John Morris & Co	Mineral Ridge.
Ohltown	"	Harris & Maurer	Mineral Ridge.
McKennie's Shaft	"	J. B. Warner & Co	Mineral Ridge.
Tibbett's Shaft	"	Junction Coal Co	Mineral Ridge.
Foulk's	Slope	Foulk Coal Co	Mineral Ridge.

Mahoning County—Continued.

Name of Mine.	Kind of Mine.	Name of Coal Company.	P. O. Address.
Pennel	Slope	New Lisbon Coal Co	Youngstown.
Haroff	"	Haroff Coal Co	Youngstown.
Thorn Hill	"	Powers and Arms	Youngstown.
Packard's	"	Packard Coal Co	Youngstown.
Powers's	"	Powers Coal Co	Youngstown.
Holland	Drift	Charles Moore & Co	Youngstown.
Jackson	Slope	Jackson Coal Co	Youngstown.
Reno's	"		
McKenny Slope	"	Mahoning Coal Co	Youngstown.
Walter's	Drift	Walters & Sheets	Washingtonville.

Muskingum County.

Zanesville Mines	Drift	John Marpool	Zanesville.
Del Carbo	"	Diamond Mining Co	Roseville.
Muskingum Valley	"	Muskingum Valley Coal Co	Roseville.
Matthews's	"	Lewis Matthews	Zanesville.
Monitor	Shaft	Cowell, Harris & Co	Zanesville.
Locust Grove	Drift	James Owens	Putnam.
Harper's Ferry	"	James Morrison	Putnam.
Ballou's	"	Orin Ballou	Zanesville.
Searval's	"	G. Searval	Philo.
Crow Run	"	Stone & Deval	Cedar Run.
Blue Rock	"	James Paterson	Blue Rock.

Note.—There are from twenty-five to thirty other mines in this county, in the neighborhood of Zanesville, but they all work less than ten men at once.

Meigs County.

Antiquity	Shaft	Ohio Coal Co	Racine.
Syracuse Shaft	"	Syracuse Coal and Salt Co	Syracuse.
Syracuse Slope	Slope	M Nye & Sons	Syracuse.
Pamunky	Drift	Pomeroy Coal Co	Pomeroy.
Williams's	"	Evan Williams	Minersville.
Minersville	"	Pomeroy Coal Co	Pomeroy.
Excelsior	"	" "	Pomeroy.
Pencreek	"	" "	Pomeroy.
Dabney	"	" "	Pomeroy.
Diamond *	"	" "	Pomeroy.
Coal Ridge	"	Coal Ridge Salt Co	Pomeroy.
Buckeye	"	Buckeye Salt Co	Pomeroy.
Middleport	"	Middleport Salt Co	Middleport.
Pomeroy's	"	S. M. Pomeroy	Pomeroy.

Noble County.

Dexter*	Drift	Ohio Coal Co	Marcella.

Perry County.

Central	Drift	Straitsville Central Mining Co	New Straitsville.
Old Straitsville	"	Straitsville Mining Co	New Straitsville.
Plummer Hill	"	Straitsville Coal Co	New Straitsville.
Troy	"	Straitsville Coal and Iron Co	New Straitsville.
Hillyer's *	"	Lancaster and Straitsville Coal Co.	New Straitsville.
Mungen's	"	Great Vein Coal and Iron Co	New Straitsville.
Youart's	"	Patterson Coal Co	New Straitsville.
Upton's	"	Card and Upton Coal Co	Shawnee.
Shields's Mines, Nos. 1, 2, 3	"	Newark Coal Co	Shawnee.

PERRY COUNTY—Continued.

Name of Mine.	Kind of mine.	Name of Coal Company.	P. O. Address.
New York	Drift	New York and Straitsville Coal Co.	Shawnee.
Lyonsdale	"	Straitsv. and Cannel C. Co. of N. Y.	Shawnee.
Furnace	"	Furnace Coal Co	Shawnee.
Shawnee Valley	"	Shawnee Valley Coal Co	Shawnee.
Taygue's	"	M. & P. Taygue	McLuny's.
Jones's	"	H. Jones & Co	McLuny's.
Tunnel Hill	"	Tunnel Hill Coal Co	New Lexington.
Selby	"	Selby Mining Co	New Lexington.
Wales's	"	Wales, Nugent & Co	New Lexington.
Crookville	"	Palmer & Haworth	Crooksville.
McCuneville	"	McCuneville Salt and Coal Co	McCuneville.
Brilliant	"	J. E. Payne & Co	McCuneville.
Black Diamond	"	Black Diamond Coal Co	McCuneville.
O. K	"	O. K. Coal Co	McCuneville.
Southern Ohio	"	Southern Ohio Coal Co	Maholm.
Anderson's	"	W. D. Anderson	Maholm.
Ferrara	"	Jas. Black	Moxahala.
Brindebal's	"	J. Brindebal	Moxahala.
Moxahala	"	Black & Son	Moxahala.

PORTAGE COUNTY.

Atwater Slope	Slope	Atwater Coal Co	Atwater.

STARK COUNTY.

Fulton	Slope	Fulton Coal Co	Canal Fulton.
Buckeye	"	Buckeye Coal Co	Canal Fulton.
Crawford	Shaft	Crawford Coal Co	Massillon.
Crawford	Slope	" "	Massillon.
Willow	"	Willow Bank Coal Co	Massillon.
Willow	Shaft	" "	Massillon.
Williamson	"	A. B. Williamson	Massillon.
Maple Grove	"	Massillon Coal and Mining Co	North Lawrence.
Aberdave	"	Youngstown Coal Co	Massillon.
Jacobs	"	Rhodes Coal Co	Massillon.
Grove	"	Grove Coal Co	Massillon.
Massillon Coal Co	"	Massillon Coal Co	Massillon.
Staeffer	Drift	J. P. Burton	Massillon.
Warrington	Shaft	Warrington Coal Co	Massillon.
Brookfield	"	H. Foultz	Massillon.
Pigeon Run	"	Lee, Howell & Co	Massillon.
Lawrence	"	J. P. Burton	Massillon.
Foultz's	Slope	Massillon City Coal Co	Massillon.

SUMMIT COUNTY.

Crawford's	Drift	Crawford & Co	Akron.
Franklin	Slope	Franklin Coal Co	Akron.
Summit	"	Summit Mine Coal Co	Akron.
Brewster Slope	"	Brewster Coal Co	Akron.
Brewster Drift	Drift	" "	Akron.
Brewster Bros	Slope	Brewster Bros	Middlebury.
Middlebury Shaft	Shaft	Middlebury Coal Co	Middlebury.
Johnson Shaft	"	Johnson Coal Co	Middlebury.
Dennison *	Drift	Dennison Coal Co	Sherman.
Nemisilla	Slope	Nemisilla Coal Mining Co	Cleveland.
Norton's	"	Norton Coal Co	Sherman.

TUSCARAWAS COUNTY.

Name of Mine.	Kind of mine.	Name of Coal Company.	P. O. Address.
Black Vein *	Drift	Black Vein Colliery Co	Dennison.
Dennison	"	Dennison Colliery Co	Dennison.
Andraes Mine	"	S. W. Andraes & Co.	Urichsville.
Stillwater	"	Tuscarawas Valley Coal Co	New Philadelphia.
Syracuse	"	Syracuse Coal Co.	Urichsville.
Pike Run, No. 1	"	Tuscarawas Valley Coal Co	New Philadelphia.
Pike Run, No. 2	"	" " "	New Philadelphia.
Rich Hill	Shaft	Rich Hill Coal Co.	Waynesburgh.
Walton Ridge	Drift	Buckeye Coal and Coke Co	New Philadelphia.
Port Washington	"	Glasgow and Port Washington Iron Co	Port Washington.
Urichsville Shaft *	Shaft		
		TRUMBULL COUNTY.	
Vienna	Shaft	Vienna Coal and Iron Co	Youngstown.
Wheeler	Slope	" " "	Youngstown.
Tyler	"	C. H. Andrew & Bro	Youngstown.
Halliday	"	Halliday Coal Co	Youngstown.
Hood	"	Arms & Wick	Youngstown.
Sodom	"	McCurdy Coal Co	Youngstown.
Church Hill Slope	"	Church Hill Coal Co.	Youngstown.
Church Hill Shaft	Shaft	Niles Coal Co	Youngstown.
Kline	Slope	Briar Hill Iron Co	Youngstown.
Moore *	"	Moore Coal Co	Youngstown.
Shenango	"	Shenango Coal Co	Wheatland, Pa.
Brookfield	"	Brookfield Coal Co	Sharon, Pa.
Burnett	"	Burnett Coal Co	Youngstown.
Jacobs ‡	Shaft	Jacobs & Son	Youngstown.
Carbon Valley †	Slope	Wick, Struthers & Co	Youngstown.
Stewart	"	Mahoning Coal Co	Youngstown.
Long Bank	"	" "	Youngstown.
Mahoning, No. 3	"	" "	Youngstown.
Chew	"	" "	Youngstown.
Cleveland	Shaft	Payne, Newton & Co	Cleveland.
Ashland	Slope	Ward, Warner & Co.	Mineral Ridge.
Weathersfield	Shaft	Wise Coal Co	Mineral Ridge.
Cambria	Slope	Ward, Warner & Co.	Mineral Ridge.
Love	"	Andrews & Hitchcock	Youngstown.
Williams	Shaft	D. Williams & Co	Hubbard.
Winfield	Slope	Winfield Coal Co	Mineral Ridge.
Curtis Hill	Drift	Curtis & Boyce	Sharon, Pa.
		VINTON COUNTY.	
Vinton Shaft	Shaft	Bancroft & Rader	Vinton Station.
Coalmont	Drift	Zaleski Coal Co	Zaleski.
Zaleski	"	" "	Zaleski.
Moonville Mine	"	Richard Coe	Moonville.
Buckeye	"	Ingham Coal Co	King's Switch.
		WAYNE COUNTY.	
Fairview	Shaft	J. P. Burton	Massillon.
Crawford ‡	Drift	Crawford, Scott & Co	Massillon.
Silver Creek, No. 1	"	Silver Creek Mining Co.	Doylestown.
Silver Creek, No. 2	Shaft	" " "	Doylestown.
		WASHINGTON COUNTY.	
Washington *	Drift	Washington Coal Co	Youngstown.
Cliff Mines	"	G. W. Linn	Coal Run.
Macksburg	"	Ohio Coal Co	Marietta.

* Idle. † Drowned. ‡ Worked out.

Statement of Traveling and Contingent Expenses from January 1, 1876, to November 14, 1876.

Jan.	2.	Postage stamps	$2 00
"	11 to 17.	Visiting Steubenville and Massillon regions	30 25
"	19 to 25.	" Mahoning Valley	27 30
"	27.	Haswell's Engineering	2 54
"	27.	Binding Reports of English Coal Commission	3 50
"	27.	" " Inspection	3 50
"	27.	Purchasing Underground Life	13 50
"	27.	Express charges on maps	2 35
"	27 to 30.	Visiting Coshocton	8 10
Feb.	2 to 4.	" Straitsville	4 00
"	5.	" Nelsonville	1 50
"	14.	Lithographs for report	16 00
"	15 to 19.	Visiting Shawnee	8 25
"	22.	Postage stamps	2 00
"	23 to 29.	Visiting Wadsworth and Akron	16 80
March	1.	Postage stamps	2 00
"	1.	Cut for report	2 00
"	1.	One copy of Coal Mines	2 00
"	6 to 12.	Visiting Salineville	22 50
"	15 to 18.	" Tuscarawas county mines	14 50
"	23.	Postage stamps	1 00
"	29 to 31.	Visiting Macksburg	11 55
April	3 to 7.	" Bellair	18 80
"	10 to 13.	" Wadsworth	10 75
"	14.	Cleaning carpet in office	3 10
"	14.	To care of office	15 00
"	17 to 21.	Visiting Cambridge	16 75
"	24 to 28.	" Massillon	20 50
May	1 to 6.	" Massillon and Salineville	23 50
"	6 to 10.	Stamps and maps	2 85
"	12 to 13.	Visiting Floodwood and Hamley's Run	2 50
"	15.	Postage stamps	2 25
"	15 to 21.	Visiting Massillon	19 80
"	22 to 24.	" Wellston and Jackson	8 50
"	31.	Express on coal plants	5 20
June	6 to 17.	Visiting Pomeroy	32 50
"	18.	Postage stamps	2 00
"	22 to 25.	Visiting Coshocton	9 50
"	28 to 30.	" Shawnee	7 50
July	1.	To care of office (3 months)	10 00
"	10 to 15.	Visiting Salineville	19 50
"	19.	Express and postage	1 90
"	19.	Notary Public	80
"	21.	Satchel for mines	5 50
"	22 to 29.	Visiting Mahoning Valley	22 90
Aug.	1 to 4.	" Salineville	11 50
"	9.	Postage stamps	2 15

Aug.	10 to 12.	Visiting Nelsonville	$4 35
"	14 to 18.	" Leetonia	13 65
"	14.	Postage stamps	2 00
"	22 to 26.	Visiting Del Carbo and Zanesville	11 50
"	28 to 31.	" Cleveland	6 00
Sept.	6 to 13.	" Lawrence county	23 10
"	15.	Postage stamps	1 00
"	18 to 21.	Visiting Shawnee	7 50
"	23 to 30.	" Mahoning Valley	19 25
Oct.	1.	To care of office (3 months)	10 00
"	2.	Postage stamps	2 00
"	11 to 15.	Visiting North Lawrence	15 20
"	20.	Postage stamps and express	2 25
"	24 to 27.	Visiting Carbondale and Haydenville	9 50
Nov.	1 to 4.	" Bellair	16 55
"	8 to 11.	" Zaleski	7 50
"		Charges on coal flora	1 75
		Total	$625 39

AN ACT

To Regulate Mines and Mining, and to Repeal an Act Therein Named.

SECTION 1. *Be it enacted by the General Assembly of the State of Ohio,* That there shall be appointed by the governor, with the advice and consent of the senate, one mine inspector, who shall hold his office for four years, subject, however, to be removed by the governor for neglect of duty or malfeasance in office. Said inspector shall have knowledge of chemistry, geology, and mineralogy, and a practical knowledge of the different systems of working and ventilating coal mines, and of the nature and properties of the noxious and poisonous gases of mines, particularly fire-damp, and mining engineering; and said inspector, before entering upon the discharge of his duties, shall take an oath or affirmation to discharge the same faithfully and impartially, which oath or affirmation shall be indorsed upon his commission, and his commission, so indorsed, shall be forthwith recorded in the office of the secretary of state, and such inspector shall give bond in the sum of five thousand dollars, with sureties to the approval of the governor, conditioned for the faithful discharge of his duty.

SEC. 2. Said inspector shall give his whole time and attention to the duties of his office, and shall examine all the mines in this state as often as his other duties will permit, to see that the provisions of this act are obeyed; and it shall be lawful for such inspector to enter, inspect, and examine any mine in this state, and the works and machinery belonging thereto, at all reasonable times, by night or by day, but so as not to unnecessarily obstruct or impede the working of the mine; and to make inquiry into the state and condition of the mine as to ventilation and general security, as required by the provisions of this act; and the owners and agent of such mine are hereby required to furnish the means necessary for such entry and inspection, of which inspection the inspector shall make a record, noting the time and all the material circumstances; and it shall be the duty of the person having charge of any mine, whenever loss of life shall occur by accident connected with the working of such mine, or by explosion, to give notice forthwith by mail, or otherwise, to the inspector of mines and to the coroner of the county in which such mine is situated, and the coroner shall hold an inquest upon the body of the person or persons whose death has been caused, and inquire carefully into the cause thereof, and shall return a copy of the verdict and all the testimony to such inspector. No person having a personal interest in, or employed in the management of, the mine where a fatal accident occurs shall be qualified to serve on the jury impanneled on the inquest.

SEC. 3. Said inspector, while in office, shall not act as an agent, or as a manager, or mining engineer, or be interested in operating any mine; and he shall, annually, on or before the first day of January, make report to the governor of his proceedings, and the condition and operation of the mines in this state, enumerating all accidents in or about the same, and giving all such other information as he may think useful and proper, and making such suggestions as he may deem important as to further legislation on the subject of mining.

SEC. 4. Said inspector shall receive a salary of two thousand dollars per annum, and his necessary traveling expenses, to be paid in quarterly installments; and he shall have and keep an office in the state house, at Columbus, in which shall be carefully kept the maps and plans of all mines in this state, and also all records and correspondence, papers and apparatus, and property, pertaining to his duties, belonging to the state, and which shall be handed over to his successor in office.

SEC. 5. Any vacancy occurring when the senate is not in session, either by death or resignation, removal by the governor, or otherwise, shall be filled by appointment by the governor, which appointment shall be good until the close of the next session of the senate, unless the vacancy is sooner filled as in the first section provided.

SEC. 6. There shall be provided for said inspector all instruments and chemical tests necessary for the discharge of his duties under this act, which shall be paid for on the certificate of the inspector, and which shall belong to the state.

SEC. 7. The owner or agent of every coal mine shall make, or cause to be made, an accurate map, or plan of the working of such mine, on a scale of not less than one hundred feet to the inch, showing the area mined or excavated, and the location and connection with such excavation of the mine of the lines of all adjoining lands, and the name or names of each owner or owners, so far as known, marked on each tract, a true copy of which map the said owner or agent shall deposit with the inspector within six months after the passage of this act, and another copy of which shall be kept at the office of such mine; and the owner or agent shall, on or before the first day of September, 1874, and every four months thereafter, file with said inspector a statement and plan of the progress of the workings of such mine up to said date, which statement and plan shall be so prepared as to enable the inspector to mark the same on the original map or plan herein required to be made. In case of refusal on the part of said owner or agent, for two months after the time designated, to make and file the map or plan, or the addition thereto, the inspector is authorized to cause an accurate map or plan of the whole of said mine to be made at the expense of the owner thereof, the cost of which shall be recoverable against the owner in the name of the person or persons making said map or plan, which shall be made in duplicate, one copy being delivered to the inspector, and the other left in the office of the mine; and he shall, on being paid the proper cost thereof, on demand of any person interested in the working of such mine, or owner of adjoining lands, furnish an accurate copy of any map or plan of the workings of such mines.

SEC. 8. Twelve months from and after the passage of this act it shall not be lawful for the owner or agent of any coal mine worked by a shaft, wherein over fifteen thousand square yards have been excavated, to employ any person to work therein, or to permit any person to work in such mine, unless there are to every seam of coal worked in each mine at least two separate outlets, separated by natural strata of not less than one hundred feet in breadth, by which shafts or outlets distinct means of ingress and egress are always available to the persons employed in the mine; but it shall not be necessary for the two outlets to belong to the same mine; and every shaft opened after the passage of this act shall have two separate outlets, after fifteen thousand square yards have been excavated; and to all other coal mines, whether slopes or drifts, two such openings or outlets shall be provided within twelve months after the passage of this act, provided fifteen thousand square yards have been excavated at or before the passage of this act, or if not, then within twelve months after that extent has been excavated. In case such outlets are not provided as herein stipulated, it shall not be lawful for the agent or owner of any such mine to permit more than ten persons to work therein at any one time. In case any coal mine has but one shaft, slope, or drift for the ingress or egress of the men working therein, and the owner thereof does not own suitable surface ground for another opening, the owner may select and appropriate any adjoining land for that purpose, and for approach thereto, and said owner shall be governed in his proceeding in appropriating such land by the provisions of law in force providing for the appropriation of private property by corporations, and such appropriation may be made whether the owner of such mine is a corporator or not; provided that no land shall be appropriated under the provisions of this act until the court is satisfied that suitable premises can not be obtained by contract upon reasonable terms.

SEC. 9. The owner or agent of every coal mine, whether shaft, slope, or drift, shall provide and maintain, within six months after the passage of this act, for every such mine, an amount of ventilation of not less than one hundred cubic feet per minute per person employed in such mine, and as much more as the inspector may direct, which shall be circulated to the face of each and every working place throughout the mine; and all mines generating fire-damp shall be kept free of standing gas, and in all mines where fire-damp is generated every working place shall be carefully examined every morning with a safety-lamp, by a competent person, before any of the workmen are allowed to enter.

SEC. 10. The owner or agent of every coal mine operated by shaft or slope, in all cases where the human voice can not be distinctly heard, shall forthwith provide and maintain a metal tube from the top to the bottom of such shaft or slope, suitably calculated for the free passage of sound therein, so that conversations may be held between persons at the bottom and top of the shaft or slope; and there shall also be provided an approved safety-catch, and a sufficient cover over head, on all carriages used for lowering and hoisting persons, and in the top of every shaft an approved safety-gate, and also an approved safety-spring on the top of every slope, and an adequate brake shall be attached to every drum or machine used for lowering or raising persons in all shafts or slopes.

SEC. 11. No owner or agent of any coal mine operated by a shaft or slope shall place in charge of any engine used for lowering into or hoisting out of such mine persons employed therein any but experienced, competent, and sober engineers; and no engineer in charge of such engine shall allow any person, except such as may be deputed for that purpose by the owner or agent, to interfere with it or any part of the machinery, and no person shall interfere or in any way intimidate the engineer in the discharge of his duties; and in no case shall more than ten men ride on any cage or car at one time, and no person shall ride upon a loaded cage or car in any shaft or slope.

SEC. 12. All the safety-lamps used for examining coal mines, or which may be used in working any mine, shall be the property of the owner of the mine, and shall be under the charge of the agent of such mine; and in all mines generating explosive gas the doors used in assisting or directing the ventilation of the mine shall be so hung and adjusted that they will shut of their own accord, and can not stand open; and in all such mines the mining boss shall keep a careful watch over the ventilating apparatus and the air-ways, and he shall measure the ventilation at least once a week at the inlet and outlet, and also at or near the face of all the entries; and all such measurements shall be reported once a month to the inspector.

SEC. 13. No boy under twelve years of age shall be allowed to work in any mine, nor any minor between the ages of twelve and sixteen years, unless he can read and write: and in all cases of minors applying for work it shall be the duty of the agent of such mine to see that the provisions of this section are not violated.

SEC. 14. In case any coal mine does not, in its appliances for the safety of the persons working therein, conform to the provisions of this act, or the owner or agent disregards the requirements of this act, any court of competent jurisdiction may, on application of the inspector, by civil action in the name of the state, enjoin or restrain the said owner or agent from working or operating such mine with more than ten miners at once, until it is made to conform to the provisions of this act; and such remedy shall be cumulative, and shall not take the place of or affect any other proceedings against such owner or agent authorized by law for the matter complained of in such action.

SEC. 15. Any miner, workman, or other person who shall knowingly injure or interfere with any safety-lamp, air course or brattice, or obstruct or throw open doors, or disturb any part of the machinery, or disobey any order given in carrying out the provisions of this act, or ride upon a loaded car or wagon in a shaft or slope, or do any act whereby the lives or health of the persons or the security of the mines and machinery is endangered, or if any miner or person employed in any mine governed by the provisions of this act shall neglect or refuse to securely prop or support the roof and entries under his control, or neglect or refuse to obey any order given by the superintendent in relation to the security of the mine in the part of the mine under his charge or control, every such person shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine not exceeding fifty dollars, or imprisonment in the county jail not exceeding thirty days, or both, at the discretion of the court.

SEC. 16. Whenever written charges of gross neglect of duty or malfeasance in office against any inspector shall be made and filed with the governor, signed by not less than fifteen coal-miners, or one or more operators of mines, together with a bond in the sum of five hundred dollars, payable to the state, and signed by two or more responsible freeholders, and conditioned for the payment of all costs and expenses arising from the investigation of such charges, it shall be the duty of the governor to convene a board of examiners, to consist of two practical coal-miners, one chemist, one mining-engineer, and one operator, at such time and place as he may deem best, giving ten days' notice to the inspector against whom the charges may be made, and also to the person whose name appears first in the charges; and said board, when so convened, and having been first duly sworn or affirmed truly to try and decide the charges made, shall summon any witnesses desired by either party, and examine them, on oath or affirmation, which may be administered by any member of the board, and depositions may be read on such examination as in other cases; and the board shall examine fully into the truth of such charges, and report the result of their investigation to the governor; and if their report shows that such inspector has grossly neglected his duties, or is incompetent, or has been guilty of malfeasance in office, it shall be the duty of the governor forthwith to remove such inspector and appoint a successor; and said board shall award the costs and expenses of such investigation against the inspector or the persons signing said bond, according to their finding against said inspector or in his favor, which costs and expenses shall include the compensation of such board of five dollars per day for each member for the time occupied in the trial, and in traveling from and to their homes; and the attorney-general shall forthwith proceed to collect such costs and expenses, and pay the same into the state treasury, the said costs and expenses being in the first instance paid out of the state treasury on the certificate of the president of such board.

SEC. 17. In all coal mines in this state, the miners employed and working therein, the owners of the land or other persons interested in the rental or royalty of any such mine, shall, at all proper times, have full right of access, and examination of all scales, machinery, or apparatus used in or about said mine to determine the quantity of coal mined, for the purpose of testing the accuracy and correction of all such scales, machinery, or apparatus; and such miners, land-owners, or other persons, may designate or appoint a competent person to act for them, who shall, at all proper times, have full right of access and examination of such scales, machinery, or apparatus, and seeing all weights and measures of coal mined, and the accounts kept of the same: Provided, not more than one person on behalf of the miners collectively, or one person on behalf of the land-owners or other persons interested in the rental or royalty jointly, shall have such right of access, examination, and inspection of scales, weights, measures, and accounts at the same time, and that such persons shall make no unnecessary interference with the use of such scales, machinery, or apparatus.

SEC. 18. The provisions of this act shall not apply to or affect any coal mine in which not more than ten men are employed at the same time: Provided, that on the application of the proprietor of or miners in any such mine, the inspector shall make, or cause to be made, an inspection of such mine, and direct and enforce any regulations in accordance with the provisions of this act that he may deem necessary for the safety of the health and lives of the miners.

SEC. 19. The act entitled an act to regulate coal mines and the working thereof, passed April 29, 1872, is hereby repealed.

SEC. 20. This act shall take effect and be in force from and after its passage.

FOURTH ANNUAL REPORT

OF THE

STATE MINE INSPECTOR,

TO THE

GOVERNOR OF THE STATE OF OHIO,

FOR THE YEAR 1877.

COLUMBUS:
NEVINS & MYERS, STATE PRINTERS.
1877.

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ANNUAL REPORT.

COLUMBUS, OHIO, *November* 15, 1877.

To His Excellency THOMAS L. YOUNG, *Governor of Ohio:*

SIR: In compliance with the requirements of law, I have the honor to submit herewith my fourth annual report as State Inspector of Mines, containing a description of the condition and operations of the coal mines examined during the year; a sketch of the structure and resources of the coal field of the State, and such other matters and information as I have deemed of importance.

During the year, several mining districts were not visited for want of time—a considerable part of my time, which would otherwise have been given to inspection of mines, being taken up with suits against mining companies for violating the mining law. A number of mines visited and inspected are also not specially reported upon, for the reason that in my last annual report their condition and manner of working were described in detail, and any extended notice of them at this time would, to a considerable extent, be repetitionary.

An estimate of the proportion of fatal accidents to the amount of coal mined, and a comparison with other States and countries, will be found at the end of the report.

The following is the list of fatal accidents, together with the causes of same, which have occurred from the 14th of November, 1876, to date:

November 24, 1876. John Drew, killed in mines of Nelsonville Mining Company, in Athens county. Fall of roof.

December 16, 1876. Hubbard Smith, killed in Silver Creek Mines, Wayne county. Fall of rock.

January 4, 1877. Nicholas Salvo, killed in Stewart Mine, Trumbull county. Fall of roof.

February 8, 1877. Richard Bennet, killed at Curtis' Hill Mine, Trumbull county. Fall of roof.

March 17, 1877. Aaron Craver, killed in Haroff Slope, Mahoning county. Suffocated by gas.

June 21, 1877. Vengeance St. Angello and Dominic St. Angello, killed in Mine No. 3 of the Mahoning Coal Company, Trumbull county. Fall of roof.

July 9, 1877. A boy (name not reported) killed in Warwick's Shaft, Stark county. Explosion of powder.

July 10, 1877. William J. Thomas, killed in Aberdave Shaft, Stark county. Fall of coal.

July 11, 1877. John Jones, Miles Davis, Richard Williams, David Jenkins, Richard Jones, John Barter, and John Young, killed in the Brookfield Slope tunnel, in Trumbull county. Suffocated by the gases from the mine locomotive.

August 8, 1877. David Morgan, killed in Kyle Shaft, Mahoning county. Crushed between cars

August 10, 1877. William Hall, killed at Scott's Mines, Guernsey county. Fall of coal.

August 12, 1877. August Henry, killed at Halliday Mine, Trumbull county. Fell on his picks while going down the slope.

September 5, 1877. Salvo Matthic, killed in Hamilton Mine, Trumbull county. Fall of roof.

September 6, 1877. Thomas Walton, killed in Stillwater Mine, Tuscarawas county. Fall of roof.

October 2, 1877. James McLain, killed in air-shaft of Brookfield Mine, Trumbull county. Fell down shaft.

October 6, 1877. Morgan Williams, killed in Shenango Mine, Trumbull county. Fall of roof.

October 6, 1877. John Shousden, killed in Burnett Mine, Trumbull county. Fall of coal.

October 11, 1877. William Clarke, killed in Pidgeon Run Mine, Stark county. Fall of roof.

October 19, 1877. William Cagg, killed in Tucker's Mine, near Straitsville, Perry county. Fall of coal.

October 28, 1877. Thomas Plant, killed in Williamson Shaft, Stark county. Fall of coal.

November 1, 1877. Thomas Simmons, killed in Ohio Coal Company's Mine, Cambridge, Guernsey county. Fall of coal.

November 1, 1877. Luke Lemmon and William I. Williams, killed in Kyle Shaft, Mahoning county. Fall of roof.

Only about one-half of the above accidents were reported to me by the officers in charge of the mines. The law requires that the person having charge of a mine shall, upon the occurrence of any fatal accident, forthwith notify the Mine Inspector, by mail or otherwise, and also the coroner of the county in which the accident occurred; but no penalty is attached to this section of the law for neglect or refusal to do so, and its provisions are generally disregarded in consequence.

I have observed an increased carelessness in the past year, both on the part of miners and mine-owners, in complying with the law. This has arisen from two causes: First, the lack of penalties to several important provisions of the act, making such provisions of no binding force; and, second, the introduction of the Monahan bill to repeal the mining law, and substitute such a system of inspection that the provisions of the act, so far as any benefit to miners was concerned, would have been a dead letter. The author of this bill did not, perhaps, have such object in view, though neither myself nor any practical miner, so far as I know, were consulted in its preparation and introduction, and the recommendations contained in my report were mostly ignored. Although the Legislature refused to consider this bill, the evil influence resulting from its introduction was none the less certain and sure.

In the beginning of April the following circular letter was sent out to the address of the different mining operators in the State:

OFFICE OF THE STATE INSPECTOR OF MINES,
COLUMBUS, *April* 3, 1877.

GENTLEMEN: You will find inclosed a copy of the "Mining Law," and I desire to call your attention to sections seven, nine, and ten of the same. I mention these three sections as provisions of the act which are being disregarded by many mine owners and agents of mines.

You will please send to this office at as early a date as practicable an accurate map or plan of the mine you are now operating, or the addition thereto, as required by section seven, showing all work up to the beginning of the present year. In case such map or additions are not forwarded by the first of March next, I will find it necessary, as the law authorizes, to cause a map to be made at the expense of the mine owners.

You are also respectfully requested to forward a statement of the amount of ventilation prevailing in the mine, not only entering by the intake and returning by the upcast, but also the amount flowing through the interior air courses where the people are employed. Any information as to the manner of measuring the volume of air, or as to any other matter connected with the mining law, will be cheerfully given on application to this office.

Where the natural forces only are employed to give motion to the air, the current during two-thirds of the year is too weak for good results, and artificial means must be applied. Many furnaces are also too small to move the column of wind required by law, and by the sanitary requirements of the mine, and they must be torn down and more powerful means applied. Gnibal's fan is the best and most reliable ventilating power in use for mines like those of our State. Prompt attention to the above suggestions is requested.

Section ten, relating to speaking-tubes, covers, and catches, and safety-gates, is not universally obeyed. Speaking-tubes are not deemed necessary in slopes, where the workmen can walk up and down at will, but in shafts, where the human voice cannot be distinctly heard and understood, they must be applied. No safety-catch will be deemed approved which has not been thoroughly tested by a loaded car on being applied.

In all mines failing to comply with the above, or any other provisions of the law, the remedies prescribed by the act to enforce obedience will be resorted to.

ANDREW ROY, *State Inspector of Mines.*

The maps of mines or the additions thereto were generally forwarded, or promises given that they would be, in response to the above circular, but very few air measurements were received. The law does not require the owners or agents of mines to furnish a statement of the currents of air in circulation, except in the case of mines generating fire-damp, and then there is no penalty attached for neglect or refusal to do so, and the "respectful request" was generally disregarded. As, however, not one in a dozen of the mine bosses are provided with anemometers to measure the amount of air in a mine, I was not greatly disappointed.

A number of mines in the State rely on the natural forces for ventilation. In very small mines this may suffice, but where fifty to a hundred men are employed underground, and the mine workings extend for a mile or more, the natural forces cannot suffice, no matter if there be half a dozen openings.

Little attention being given to the above circular letter in respect to ventilating improvements, I issued another on the 25th of July, as follows:

OFFICE OF THE STATE MINE INSPECTOR,
COLUMBUS, OHIO, *July* 25, 1877.

To the Mine Owners, Mine Superintendents, and Miners of Ohio:

I desire to call your attention to the fact that some of the most important provisions of the mining law are not receiving that attention from you that their importance demands. During the past few weeks complaints have been quite common as to the want of fresh air in the mines. Every mine should have a ventilating furnace or fan, the latter being the preferable ventilator; also an air-shaft, and the deeper the air-shaft the better, particularly where furnace ventilation is applied. In some cases, where bad air exists, mine superintendents attribute this condition to the weather outside. Section IX provides that a hundred cubic feet of air per man per minute shall be circulated to the working faces of mines. This can be done without regard to weather, and excuses as to bad weather are altogether frivolous. Mine superintendents are requested to measure the amount of air in circulation at least once per month, not only at the intake and upcast, but also in all the interior air courses, and to forward the result of such measurement to me at Columbus. If the amount of air in circulation in the mines equals that required by law, and is properly distributed, there can be no just complaint of bad air. Any person desiring information as to the manner of measuring the air of mines will be cheerfully informed upon application. A few minutes' explanation as to how to read an anemometer will suffice for any person who knows the first four rules of arithmetic. Anemometers are not manufactured in this country, and have to be imported. I will take pleasure in informing those desiring such instruments how and where to procure them.

Section XV of the law, which provides that it shall be a misdemeanor for any person to ride in a shaft or slope upon a loaded car, is daily disregarded in a number of mines, and the names of such persons are withheld from me. All persons connected with the mines, whether as employers or employés, knowing of any infringement of this section of the law, are earnestly requested, both in behalf of the law and of those who ignore its provisions, to send me the names of such parties, in order that this practice may be stopped, even if the rigors of the law have to be enforced to compel obedience. It is false sympathy towards men who ride in slopes and shafts on loaded cars not to report them, for in a moment they may be launched into eternity.

In many of the main galleries and hauling roads of mines there is not room between the roadway and pillars while cars are passing to and fro. Although the law does not require it, the safety of the miners induces me to request mine owners and superintend_

ents to have man-holes, cut large enough for two or three men, along such galleries and roadways, every fifty yards or less.

This circular is issued with the hope that I may be called upon only to assist mine owners and mine superintendents in complying with the law, so that in no case I may be compelled to resort to the powers conferred by the law to enforce its provisions.

The recent calamity at the Brookfield Mine, in Trumbull county, by which seven miners were suffocated, should prompt all persons connected with the mines to increased supervision and watchfulness. Whenever it is proposed to introduce into any mine a locomotive, or other machinery calculated to vitiate the air of mines, or anything that may, by any possibility, change the existing conditions as to safety, owners, superintendents, or miners are respectfully but earnestly requested to notify me at once, and I will cheerfully, upon every such occasion, make such suggestions as I may deem best for the interest of all concerned.

Respectfully, ANDREW ROY, *State Mine Inspector*.

The above circular letter was followed by another on August 28th, as follows:

OFFICE OF THE STATE MINE INSPECTOR,
COLUMBUS, OHIO, *August* 28, 1877.

To the Mine Owners and Mine Superintendents of Ohio:

Several weeks ago a circular letter, dated July 25th, was mailed to you, calling your attention to certain sections of the mining law which were being disregarded at many mines in the State. Section IX., which requires that one hundred cubic feet of air per man per minute shall be circulated in every mine, was specially referred to as not being complied with at many mines, and mine superintendents were requested to measure the column of air in circulation, and forward the result to me at Columbus. Many mine owners and mine superintendents, instead of measuring the air as requested, have set up the claim that the amount of current required by the statute can not be provided and maintained. This claim has no foundation in fact, and no mine can be thoroughly and well ventilated unless the letter and spirit of the law is complied with. Every mine in the State can be provided with many times the amount of air the law requires, if the necessary conditions are applied, and several mines now have from thirty thousand to sixty thousand cubic feet of air per minute, or from three hundred to five hundred cubic feet per person employed.

The following conditions, which ought to prevail and do prevail at all well regulated mines, will move and distribute such a current of air that complaint as to the want of fresh air in a single working place of a mine will be impossible:

Every mine coming within the provisions of the statute, whether shaft, slope or drift, should have an air shaft, the deeper the better, and a ventilating furnace or fan. The furnace should be at least five and a half feet wide, three and a half feet high above the bars, two feet below the bars, and thirty feet long. The upcast shaft should be perfectly dry, to insure which it should, if necessary, be lined from top to bottom with noncombustible material. The sectional area of the upcast shaft, and of every air-course in the mine, should be at least thirty feet, and all air-courses should be kept abreast of the entries. Double entries should be driven in all mines where the conditions are at all favorable, and break-throughs made every one hundred feet. There is neither economy nor necessity for single entries in nine-tenths of the mines of the State; but where such entries are driven, no miners should be allowed to work ahead of the air, except the entry men, and in no case should entry men, or men in rooms, be more than one hundred

feet ahead of the air-course. All air-ways should be thoroughly overhauled once every month, all leaks promptly stopped, and all stoppings closed as new break-throughs are made. All trap-doors used for guiding and directing the air-currents of mines, should be so hung and adjusted that they will shut off their own accord, and cannot stand open. The amount of air in circulation should be measured at the intake and at the interior end of every air-way, at least once a month.

In all mines where the above or similar conditions do not prevail, mine owners and responsible managers are earnestly requested to cause the mines under their control to conform to said conditions without delay. Suits have recently been commenced against a number of mines in the Mahoning and Hocking valleys by reason of non-compliance with the law, and I propose to institute legal proceedings against any and every mine in the State in which the provisions of the law as to ventilation, or in any other regard, are not complied with. Any mine owner or superintendent not having a copy of the law, will be furnished with the same on application to me at Columbus.

Respectfully,

ANDREW ROY, *State Mine Inspector.*

The following was also sent out to the leading operative miners, with the request that it be read to the miners in each mine:

OFFICE OF THE STATE MINE INSPECTOR,
COLUMBUS, OHIO, *August* 29, 1877.

To the Coal Miners of Ohio:

It has been reported to me that in a number of mines in the State, many miners are in the habit of riding up slopes and shafts on loaded cars; of passing through doors and leaving them standing open, and also that the mining law is being violated in other regards. Such acts render the parties so offending liable to fine and imprisonment, and all offenders are hereby notified that any repetition of these practices will be visited by complaint before the proper courts. All persons connected with the mines, whether as miners or other employés, are earnestly requested to report to me at Columbus, the names of all offenders, so that they may be dealt with as the law directs.

ANDREW ROY, *State Mine Inspector.*

In the month of January, complaint was made in the proper courts against the Diamond Mine, in Medina county, Humphrey and Coleman operators, by reason of defective ventilation; also against the Williamson Mine, in Stark county, for failures to apply safety-catches and cover on the cage; and the Burton Mine, in Stark county, for want of a second opening, and because of defective ventilation. The owners of the Williamson and Burton mines notified me that if the suits against their mines were held in abeyance, and they were given a few weeks time, they would at once proceed to comply with the law. In the case of the Diamond Mine, in Medina county, an injunction was granted by the court, enjoining and restraining the mine owners from working the mine with more than ten persons at once until it was made to conform to the law. The operators of this mine respected the injunction only a few days, when they commenced working with a full force of miners. I immediately, through an attorney, directed the arrest of Messrs. Humphrey and Coleman, but the Probate Judge who granted the injunction refused to issue the papers, alleging that he had no power to enforce his own order. I then went down to the mine, and found the owners busy at work improving the ventilation, and on the assurance of one of the owners that every thing would be done which the law requires, and no cause for complaint be permitted to exist in the future, I ordered the injunction to be set aside.

In the month of April, legal proceedings were commenced against the the owners of the Osborne Shaft and the Foster Shaft, situate in Mahoning county, each of these mines having but one opening. In the case of the Foster Shaft, the mine owners, as soon as the petition was filed in court asking for an injunction to restrain the working of the mine with more than ten miners at once until two openings shall have been provided, reduced the working force to ten men under ground, but the Osborne Shaft continued to be operated in violation of the law, until the 12th of the present month, when the under-ground force was reduced to ten men. The case was heard before Judge E. B. Taylor on the 14th.

On the 18th of May, complaint was made against the owners of the the Rush Run Shaft, in Jefferson county, by reason of there being but one outlet to the mine, and an injunction was immediately granted by the court, restraining the operators from working more than ten miners at once until the law was complied with.

Mines which had two shaft-openings, but no available means of ingress and egress in the second opening, were deemed by the operators as conforming to the spirit of the law. As many of such mines had ventilating furnaces placed at the bottom of the second opening, and were without ladders or other means for the withdrawal of the miners, I resolved to test such cases in the courts, and have a legal decision for my guidance. Accordingly suits were commenced in the month of August against the owners of the Halliday Mine, the Sodom Mine, the Hood Mine, and the Kline Mine, in Trumbull county; and the Pennel Mine, the Kyle Mine, and the Powers Mine, in Mahoning county, for not having available means of ingress and egress in the second opening. Most of the mine owners, on being notified of the suits, informed me that rather than have any trial they would cause the mine to conform to any recommendations I would make. I recommended that the second shaft, at the bottom of which the ventilating furnace is placed, be divided into compartments, one side to be used as an up-cast for the esca smoke and gases of the furnace, and the other to be provided with a ladder, for the escape of the miners in case of necessity.

The ladders were put in the shafts, but the partitions were not provided, the mine owners deeming that the law did not require them. I made a test case of the Kyle Shaft, and all the proceedings in connection with the trial will be found further on in the report.

Suits were also commenced against several other mine owners in the Mahoning valley, during the summer, for not providing safety-catches, covers for cages, etc., as the law requires, and complaint was also made against a number of mines in Athens county, by reason of defective ventilation. Quite a number of the more extensive mines in the Nelsonville, Shawnee, and Straitsville districts have no artificial means of ventilation, and the owners seem unwilling to provide it, alleging that by reason of the numerous openings to day, the natural forces suffice for the sanitary requirements of the mine. At certain seasons of the year this may be true, provided no gunpowder were used during working hours; but after having inspected such mines at all times and seasons, and measured the amount of air flowing through the entries, I find the ventilation defective, frequently to a very injurious degree, and unless air-shafts are sunk and furnace power applied, or fan ventilation provided, I will be obliged to complain against at least a dozen mines in these districts, and ask for an injunction to forbid the working more than ten men at once until the law is complied with.

The suits against the Athens county mines have not yet been reached.

In calling the attention of mine owners to the want of fresh air in the workings of mines, they often express surprise that complaint is possible, claiming that it is to their interest to ventilate well, and they point to the air-shafts, air-drafts, and air-doors of mines as proof of the fact. It is true only in a certain sense that it is to their interest to ventilate well, for unless air-courses are driven, air-doors hung, stoppings built, and air-shafts sunk, the air of a mine would stagnate, and soon become so vitiated by the gases evolved from the coal and from its associate strata, by explosion of gunpowder, the lights in the mine, and the emanations from the lungs and bodies of the workmen, that neither light nor life could be sustained. Hundreds of dollars are annually expended for ventilation in even the worst aired mines. It is for the very reason that it costs money to ventilate, that bad air is possible. It might cost $4,000 a year to maintain the furnace, drive the necessary air-ways, and build the necessary stoppings, in order to discharge the air at the working faces and renew the circulation in such a manner that the noxious and poisonous gases can not accumulate, while $2,000 expended for the same purposes might so far renew the air that lights would burn, yet the sluggish current be charged with white-damp and black-damp to such an extent that a few weeks' or months' abode in such an atmosphere would stiffen the bodies of the miners and otherwise prostrate their energies. This was formerly, and is yet to a considerable extent, the condition of a number of working places in many mines.

Badly ventilated mines are not always due to the want of an expenditure of money. The mine bosses are very often to blame. Sometimes they are ignorant of the mechanics of ventilation, and spend many times the amount of money required to ventilate, yet seldom have good air. Sometimes—indeed, very frequently—they are careless, and never think of the air except when their attention is called to its condition by the miners, and then, instead of attending to the matter at once, they will probably reply, "Oh, I have often worked in worse air than that when I was digging. You are always grumbling about bad air." I have frequently found this condition of a mine under the supervision of a boss who, when he was digging coal himself, was a windy clamorer for legislation to compel mine owners to ventilate well. If the furnace or fan can move the amount of air required for the sanitary condition of a mine, the boss is to blame if the air is not properly distributed, unless he can show that he is not permitted to drive air-ways, hang doors, and build stoppings at points where they are needed.

An inspection of a mine often shows gross carelessness or incompetency on the part of mine bosses—doors which should be hung, neglected, stoppings which should be built, standing open, air-ways which should be driven, away back hundreds of feet behind the face of the entries. In mines which generate fire-damp, little prompting is needed on the part of a mine inspector to have good air. The fire-damp itself is an ever-vigilant prompter, and will take no excuse. The moment neglect occurs an explosion follows. For the reason that where fire-damp exists there must be good air or ruin, many miners will take the risks of explosion and work in such mines in preference to mines in which no explosive gas exists, if the latter are known to be badly ventilated. Superior men are generally sought out and placed in charge of fire-damp mines, because explosion, in addition to destroying the lives of the miners, destroys the ventilating and other arrangements of the mine. Men who can not tell why air, when heated, flies upward, are frequently regard as fitted to boss and ventilate a non-explosive mine.

STEUBENVILLE.

The Bustard Shaft is situate one mile above Steub
of the Ohio River, and is the upper of the seri

mines now working—the Allikanna and Cable Pits being idle. The Bustard was idle for several years, but started up again in 1875, and is now running a full force of men. The shaft is eighty-five feet deep; an escapement-shaft, one hundred and five feet deep, situate to the east of the main opening, was sunk last year. This pit is provided with a series of ladders, resting on platforms, for the speedy egress of the miners in case of accident to the main pit. The ventilation of the mine is good, and fire-damp is never seen in any of the working-places.

The main entry runs on the face of the coal, its line of direction being about twenty degrees to the west of south. All the workings are to the west of the main entry. The rooms are made eighteen feet wide, the pillars twenty-four feet thick, and the entries and cross-cuts twelve feet wide. The cross-cuts are seventy-two feet apart, the rooms and cross-cuts crossing each other, like latitude and longitude lines.

This plan of laying off the workings prevails at all the other mines of the district. The roof of the coal is sometimes sandstone and sometimes shale; the coal ranges from three feet eight inches to four feet seven inches in thickness.

The Gravel Shaft—so called because it was sunk in a gravel bed, the ancient bed of the Ohio River—is eighty-nine feet deep. An escapement and air-shaft, situate two hundred feet south of the hoisting pit, was completed in November of last year. The air-shaft is circular in form, of six feet in diameter, and is lined with brick for sixty-four feet, from the top down. Before it was commenced, another shaft was sunk farther up the river, on the site of an abandoned pit of many years, where two or three acres of coal had been excavated. After the shaft was finished, it was found that the area excavated in former years had undergone a creep—the roof and floor being nearly together—and the pit was abandoned, and the present second opening commenced. This new shaft is provided with a wire ladder, with gas-pipe rungs, for the egress of the miners in case of accident to the mine.

The ventilating current of the Gravel Shaft is due to the influence of a steam-pump placed at the bottom of the upcast compartment, and also to exhaust steam from a horizontal engine used for hauling the loaded mine cars up the "dip." The current of air is amply sufficient for the requirements of the mine, but it is proposed to erect a furnace at the bottom of the air-shaft as soon as its necessity shall become apparent.

The main entry of this mine runs seventy degrees west in the butts of the coal. The entry dipped constantly and regularly for five hundred and fifty feet, the dip, or low place, being eighteen feet lower than the bottom of the pit. A stationary engine, of ten horse power, is placed at the bottom of the shaft, to which is attached a three-foot diameter drum, and a three-quarter inch wire rope. The loaded cars are hauled from the dip to the pit bottom by this engine, the empty cars running back by the force of gravitation; six mine cars, each holding fifteen bushels, make a trip. This engine does the work of four mules and drivers; two hands are needed with the engine—a boy to attend the trips to and fro in case the cars should fly the track, and an engineer.

Eight hundred feet from the bottom of the shaft, the first face entry, called the first right-hand, extends to the north. This entry opened up part of the mine where the shale cover was still very light, and, at my suggestion, the work being opened on it was abandoned, to be renewed as the mine is being worked up. Six hundred feet inside of the first right-hand, the second right-hand is opened, and thus, as the main gallery extends forward in the butts, new right-hand entries are opened up. On the left, or south side of the main entry, the same process is repeated, these entries being known as the first left, second left, etc. These entries are locally called flats, and from them the putters receive the empty cars, which they push up to the face of the miners' working-places, and return with the full ones to the mule stations.

The Stony Hollow and Market Street Shafts come next in descending the river. These mines form one colliery, and are under the charge of one underground manager. The Market Street Pit is situate at the head of Market Street, three-quarters of a mile west of the river, and is the oldest opening of the Steubenville series, the pit having been sunk in the year 18—, by William Everick, an experienced, practical miner from the north of England. The manner of laying out the workings in the other pits were modeled after the practice in this mine. The owners of this mine have intended for two years past to widen out and re-timber the pit, and have delayed the work from time to time owing to the depressed condition of the coal and iron trades. The Rolling Mill Shaft, the Everick Shaft, and the Boreland Shaft, are each located near the river, the two latter immediately upon the river bank. There are a number of drift mines opened on the Pittsburgh coal, which lies five hundred feet or more above the horizon of the shaft coal; but none of these opening come under the requirements of the mining law. The coal of the Pittsburgh bed is about five feet thick, and is mined and used for local consumption only.

Mingo Shaft is situate two miles south-east of Boreland's, on the line of dip of the coal strata. Both shafts are exactly one depth, namely, two hundred and thirty-five feet, but Mingo's is located on ten feet higher ground than Boreland's, and hence the coal seam, instead of dipping to the south-east, between these shafts, reverses itself and forms an anticlinal. Whether the associate strata partake of this reverse dip, I know not, but the matter could be easily determined by measuring the distance from the shaft coal up to the two-foot coal in the barren measures, this latter seam being well exposed in the hills of both shafts. The fact that the coal in the Mingo Shaft is fully eighteen inches thinner than at Boreland's, leads me to infer that this anticlinal in the floor of the shaft coal existed at the time of the deposition of the coal vegetation, for, as I have frequently shown, a coal seam invariably loses height on the ridges or high lands of the old coal marsh.

The Mingo Shaft appears to have been sunk on the arch of this anticlinal, as the coal dips in all directions from the bottom of the shaft. The north entry, which is advanced three thousand two hundred and fifty feet from the bottom of the pit, dipped sixteen and one-half feet in this distance, and the coal gained nearly one foot in thickness.

The plan of laying out the workings, which prevails at all the Steubenville mines, is modeled after the practice followed in the collieries in the north of England. The pillars left in the English mines are larger and stronger than those in Steubenville, because the pits are so much deeper in the Old Country, some of them reaching one thousand eight hundred to two thousand five hundred feet of perpendicular depth. In Steubenville the rooms are eighteen feet wide, the walls or cross-cuts twelve feet wide, the pillars twenty-four feet in thickness and seventy-two feet in length. The walls and rooms cross each other like latitude and longitude lines, the walls being driven on the butts, and the rooms on the face of the coal. The main entries are ten feet wide. The miners get seventy-five cents per yard, besides the tonnage price for driving entry, but nothing is allowed for wall driving.

The mine cars hold twelve and one-half to fifteen bushels, and are pushed out from the room faces to the stations on the hauling roads by putters or pushers. In Boreland's Shaft, Shetland ponies are used instead of putters. These ponies are only three feet two inches to three feet six inches high. This mine has seven of these hardy and useful animals under ground. In the galleries and hauling roads a foot or more of the fire-clay floor is taken up to make height for the hauling mules. These roads are made five feet two inches high above the rail, and the track is laid with "T" iron. The coal hewers dig and load the coal, the deputies laying track and setting props in the rooms. Every digger works by candle light, instead of the ordinary miner's lamp. The candles are made very small, there being twenty to the pound; they are fastened to the pillar side with a piece of soft clay. Three to three and a half of these candles are consumed per day by each miner. The candles give less light than the miner's lamp, but they make no smoke, and miners who are in the habit of using them prefer them to the lamp. The deputies and drivers use lamps.

In mining the coal, powder is used to knock it down, each digger firing three shots per day on an average, two in the top and one in the bottom coal. The workmen fire at all hours of the day; but a few inches of powder suffices for a "shot," and not more than three pounds of powder per man per week is needed for blasting purposes. No blasting is done in the solid coal; a shot is undercut to the depth of four feet, if the miner is a skillful workman.

The mine mules are kept day and night under ground; the stables are hewn out of the solid coal pillars at the bottom of the pit, and are dry, well aired, and comfortable. The mules are fed at four o'clock in the morning by the fire-viewers. Work commencing at six o'clock, an hour is allowed at noon for dinner, and work ceasing at five in the evening.

The miners are paid every two weeks in cash, and there are no store orders forced upon them, as is done in many other districts of the State. As the Bustard, the Gravel, the Stony Hollow, the Market Street, the Rolling Mill, the Evericks, and Boreland Shafts are all situated in Steubenville or its immediate vicinity, the miners live in town, and a large number of them own the houses and lots in which they live, and have, in many cases, other property. Fully one-half of them take daily newspapers, though it must be confessed that here, as well as everywhere else in the Union, not a few spend much of their hard earnings in the saloons in soul-debasing pleasures.

At four o'clock in the morning the fire-viewers, consisting of the underground manager and two or three assistants called deputies, go down the pit with safety-lamps in hand, and until they have traversed the mine and signalled back that all is safe, no person, under any circumstances, is allowed to descend. The fire-viewers, on receiving orders from their chief, start out in different directions and examine the numerous chambers with the safety-lamp. If gas is met in any of the rooms, it is usually driven out by the viewer, who, leaving his safety-lamp back in the pure atmosphere, takes off his coat and slashes among the gas till it is all driven out and diluted among the common air. Should the gas be so copious that it can not be discharged, the place is marked, and all persons are forbidden to enter until the air is got up and made to play on the wall face. This condition of a working place is, however, seldom met, so admirable are the ventilating arrangements of these mi
Having made the round of the mine, the deputies meet the

one of the stations previously agreed upon, and report. Everything being satisfactory, all return to the bottom, and the signal is given to the miners to descend.

With an underground force of one hundred men there will be one boss, three deputies, five or six drivers, ten to twelve putters, two hitchers, and one attendant on the mules, the rest of the workmen being diggers of coal. During the working-hours of the day the boss and his assistants usually make another round of the mine.

Though all the mines in the Steubenville district make fire-damp, there has not been a single accident by explosion during my four years of official duty. For this immunity from danger, the underground managers of the several mines are entitled to the highest credit. There is not a great amount of fire-damp evolved in the mines, as compared with the fiery mines of England, still there is enough of it to produce the most dreadful consequences were less elaborate precautions used to prevent explosion. The accident which occurred in the Rolling Mill Shaft, in the year 1862, by which six out of the seven miners then in the pit were burned to death by an explosion of gas, is ample proof of the necessity of untiring watchfulness. Several miners have been burned, though none of them seriously, in other districts of the State, by explosions of fire-damp in mines which do not discharge one-twentieth of the volume of gas given off in the most harmless of the Steubenville mines. There has not been a single life lost in the State from this cause in the past four years.

The Bustard and Gravel Shafts have air or escape shafts, being without connection with adjoining mines, but the Rolling Mill Pit is through on the Everick Shaft, and this latter is also through on Boreland's, so that no escape shafts are needed for these mines.

The workings of the Stony Hollow and Market Street Mines are also holed through on each other, the former shaft-workings being in reality an extension of the northern workings of the latter mines, both mines belonging to the Steubenville Coal Mining Company. These pits are about two thousand feet apart, Stony Hollow being nearly due north of Market Street. The horizon of the coal in the bottom of the Stony Hollow Pit, is twenty-two feet higher than in the bottom of the Market Street Pit, and this raise occurs in the last seven hundred feet in approaching Stony Hollow.

The Rolling Mill Shaft has a pair of entries sixteen hundred feet in length, driven in an eastern direction from the bottom of the shaft. They passed directly under the Ohio River, and were stopped after passing one hundred feet into West Virginia. At this point they encountered a feeder of water, and the coal itself became so soft that it was deemed prudent to stop operations.

The entries dipped all the way from the bottom of the shaft till within four hundred feet of the West Virginia side of the river, the low place or basin being twenty-two feet lower than the bottom of the shaft. From this point until they were stopped, there was a gradual raise in the entries.

Several years ago a creep commenced in the workings of the Rolling Mill Shaft. Fifty rooms in the Rolling Mill Pit were involved in the creep; which then extended to Evericks, closing the main galleries of that mine for a width of four hundred feet, and overrunning the most valuable portion of the mine, being resisted only by the solid body of coal at the room faces. The superincumbent strata, westward of these shafts, are fully five hundred feet thick, and are mainly composed of heavy beds of sandstone. The roof and floor of the mine came together by the pillars sinking into the floor, and new roads had to be cut out of the bottom, at great labor and expense.

The mining properties of several of the coal companies border each other. By common consent, a barrier-pillar forty feet in thickness, is left at the boundary line—twenty feet by each company. This is a wise precaution, and should be required by law at all mines in the State. Already considerable annoyance has been caused in consequence of one mining company working up to, or trespassing upon the boundary of an adjoining company, and eventually, serious accidents from gas or water will result.

The Rolling Mill Shaft, Everick's, Boreland's, and Rush Run have extended their workings under the Ohio River; but all such work is now abandoned, never to be renewed. The depth of coal below the river, in the Rolling Mill Shaft, where the two eastern entries pass into West Virginia, is according to the grouped sections of Dr. Newberry's reports, only one hundred feet. As these entries passed entirely under the river to the Virginia side, this fact proves that at this point at least the ancient bed of the Ohio River is very little deeper than the present bed. A few yards in advance of the point where the entries were stopped, a bold hill begins to rise, but the soft coal, fragile roof, and rushing waters met at the entry face underground, demonstrate that the lowest place of the old river bed was near the spot where these entries were abandoned.

In the main entry of the grand shaft, in the dip or low place, five hundred and fifty feet from the bottom of the pit, the course of the river in ancient times had its lowest groove. At this place the coal is soft, the roof friable, and the coal and roof shales appear to have been lifted up.

out of place for a foot or eighteen inches, and forced back on top of the strata, the top coal and shale being duplicated for ten or twelve feet. At this place the coal is not more than seventy to seventy-five feet below the present bed of the Ohio, and there is doubtless less than twenty feet of shale overlying the coal. A few yards south of the main entry, about midway between the dip and the bottom of the shaft, the air-shaft is sunk, and forty feet of rocky strata were passed through in putting it down.

In the Bustard Shaft, the coal splits in two, the upper stratum ranging from six to eight inches in thickness. The shale parting, so far as the workings have extended, is never more than four inches thick.

In the Gravel Shaft, three-fourths of a mile south of Bustard's, the interval between the coals is greater. As in Bustard's, these coals are frequently together, and form a perfect seam; but when they split the divergence is more rapid and extended, two and three feet of shale frequently intervening.

In Quinn's room, in the second right hand entry of the Gravel Shaft, the coals coalesce on the right side of the room, and both parts are cut down and loaded, while on the left side the shale has intervened, and the top coal is left unwrought. In the Stony Hollow and Market Street Shafts, still further south, these coals are still sometimes together, but are generally separated by intercalated strata, the seams diverging four, six, eight, ten and twelve feet.

In some parts of the Gravel Shaft, where the two coals split, the casts of *sigilerea* lie stretched in the shale parting between the coals, and are frequently found imbedded in the upper coal in as perfect form as in the shale itself. They are usually rather small specimens of this flora, though I have measured some lying in the coal twenty to twenty-five feet in length.

During the summer vacation of the Agricultural and Mechanical College, two of the students, Messrs. C. H. Deitrick and J. S. Humphreys, went down to Steubenville and wrought in the mines, in order to learn, by actual practice and personal observation, the manner of mining, and the system of laying out the workings, and of ventilation, which prevailed in this district. These gentlemen propose to enter the School of Mines in the Agricultural and Mechanical College, as soon as that department is opened, with a view of fitting themselves for practical mining and engineering work, a profession which opens up a wide field of usefulness in the State.

Now that provision has been made in the Agricultural and Mechanical College for instruction in mining engineering, it is to be hoped that the practical men of the mines will avail themselves of the opportunities offered to become informed on those questions of physics with which they are daily called to deal.

HAMMONDSVILLE.

The mine of the Hammondsville Coal and Coke Company, located at Hammondsville, in Jefferson county, is opened on a seam of coal ranging from twenty-six to thirty inches in height, called the "Strip Vein." This is not the equivalent of the Salineville strip vein, which is the representative of Coal No. 7, but of a seam one hundred feet lower in the series, and is the representative of No. 4. The coal, where the mine is opened, is on a level with Yellow Creek, and is reached by a shallow shaft. This work has been in operation since 1862, and the workings extends one thousand yards from the bottom of the pit. The hauling is done by boys, who make from eight to ten trips a day, a loaded car holding eight bushels. Formerly mules were used for hauling underground, but the mine-operators seem to think boys can do the work cheaper. The hauling roads are made from four to five feet in height, but only the height of coal is cut away in the rooms, the miner doing the work of hewing and loading the coal in a chamber not more than thirty inches in height.

As the workings of this mine were pushed under the hill, the overlying strata reached 300 feet in thickness. The rooms in the mine were made fourteen feet wide, the pillars left being ten to twelve feet thick. Too weak pillars were thus left for the support of the superincumbent rocks, and, as a result, the pillars have crushed, and the roof and floor come together over the greater portion of the mine, the crush following up as newer excavations are made. The gases in the strata became liberated with the crushing of the old workings, filling the mine with black-damp. During the summer this gas spread through the workings, and sometimes drove the miners home. A new furnace was then constructed at the mouth of an old drift, and a brick chimney built on top of it. This made two ventilating furnaces to the mine, and improved the air, but they are too small, the stalks or shafts too confined and short, and the return air-courses too contracted by the crushing of the roof to allow of a vigorous ventilation. I suggested some changes, during an official visit to the mine, which would improve the air. T mining concern needs a greater expenditure than it is worth to pu first-class condition.

BELMONT COUNTY.

The Walnut Hill Mine is situate on the Ohio River, fifteen miles below Steubenville and eleven miles above Bellaire, and is the first of the series of mines of the Bellaire district opened on the Pittsburgh coal. The coal is about 350 feet above the Ohio River, and is reached by an inclined plane. This mine was formerly operated by the Ohio and Pennsylvania Coal Company, but is now being wrought by S. W. Bloomer. The old opening, around the hill, has been abandoned, and the coal is now brought out of a drift at the head of the inclined plane. The main entry goes northward, quartering on the face of the coal for four hundred yards, then changes square on the face. Four butt entries, two on the right and two on the left of the main entry, are now working. The entries are seven feet wide; the rooms are started off at six feet, advanced this width for fifteen feet, then enlarged to twenty four feet, the pillars between rooms being six feet thick. There is now an air-shaft and ventilating furnace in this mine, and the air is well distributed. The current enters by the main drift, passes along the face entry to an air-course outside of the first right butt, thence down this entry to the main entry again, thence from the main entry to the inner butt entry, thence to an air-course driven along the face of the coal to the ventilating furnace at the bottom of the upcast shaft.

The Rainey Mine, operated by the Rainey Coal Bank Company, is two miles below the Walnut Hill Mine. The main entry is opened on the butts of the coal in a westerly direction. Three paraliel entries, separated from each other by pillars of coal thirty feet in thickness, are carried forward two thousand feet from the mouth of the mine. Thence to the face of the main gallery, only two entries are advanced. A face entry runs to the right, being started at the point where the third parallel is abandoned. After advancing six hundred feet, this entry wheels round on the butts, and opens up a series of rooms which will advance to the line of the mining property. On the left of the main entry, another square of work is opened by a face entry driven to the south five hundred feet, thence to the west for six hundred feet. The working force of the mine, one hundred and twenty in number, are mainly employed on these parts of the mine. The rooms are made seven to eight yards wide; pillars, two yards in thickness, are left between each room; and it is aimed to make no break-throughs between rooms, this method being what the Scotch call "Ranse working."

The ventilating furnace of this mine is located near the entrance of the drift, and the air-shaft consists of a stone stalk built at the cone outcrop. The furnace arch is too high and the stalk too short for good results.

For a mine of the ordinary production of the Bellaire district—these mines usually employing less than forty miners at once—the ventilating arrangements of this mine would suffice; but where a force of men exceeding one hundred in number are employed, they are wholly insufficient. One of the interior entrances of the mine was approaching a ravine which cuts through the coal, allowing a passage way to day. I urged that this entry be driven out to day as rapidly as possible, and the intake current taken from it instead of from the main entry, as is now done. This would increase the force of the current by lessening the distance it would have to travel, and would also deliver the fresh air direct from day around the working places of the miners. The ventilating furnace, also, ought to be torn down and rebuilt, if good results are desired to be achieved.

Kidd's Mine, situate five miles west of Bellaire, on the line of the Baltimore and Ohio Railroad, has two level free openings—the old mine and the new mine. All the coal is taken from the new opening. The main entry runs northward on the face of the coal, nearly parallel with a swamp or trough. Two butt entries were working at the date of inspection in June last—one to the west, the other to the east—both opened from off the main entry. The west entry will run to day on McMahon Creek; the east entry to the boundary of the mining property. Both of these entries rise rapidly out of the swamp, the east one being so steep at the face that it is proposed to abandon it for the time being, and open a new mine to the east on the plateau or arch of the strata.

The mine is laid out by driving the entries eight feet wide, starting the rooms at fifteen feet, then enlarging them to twenty-four feet, leaving pillars six to ten feet in thickness between rooms. The ventilation is by the natural forces, the air sometimes going in at the new opening and sometimes at the old one. As the mine works a small force of men, usually less than twenty, and as the arrangements for distributing the air are good, there is no bad air in the mine.

The pillar coal left in this mine, equally with all the mines opened in the Pittsburgh coal in Belmont county, fully forty per cent. of the bed is sacrificed. Mr. Kidd, who is a practical miner from boyhood, says he has carefully calculated the cost of recovering the pillars, and has concluded that it pays to abandon them. Coal in abundant and cheap. What the mine owners want is immediate returns for the capital invested; hence wide room workings and narrow pillar supports lessen the cost of getting the coal in the first stage of mining, and increase the
and danger of robbing the pillars in finishing up the mine.
thinks it may be to the interest of the State to see that

properly mined for the sake of those who will come after us; but where there is no restriction of this kind, operators of mines will continue to work out the coal in the manner that brings them the best direct returns, no matter what per cent. may be lost.

Stewart & Meehan's Mine, situate at Franklin Station, two miles west of Kidd's, is opened on the butts of the coal. The main entry, which consists of three parallel headings separated from each other by pillars thirty feet in thickness, advances forward through the center of the mining property—on a line nineteen degrees north of west—rooms being worked to the north of the north parallel entry and to the south of the south parallel. Five hundred feet from the mouth of the mine a face entry runs north, and one hundred and twenty yards from its entrance a second butt entry extending west on a line parallel with the main entry, opens up the mining property so as to reach the northern boundary with rooms. The workings to the right of the main gallery are laid out in a series of blocks or squares, face air courses being driven from one butt entry to the other. On the left of the main entry the rooms are worked down one hundred yards and finished. One thousand feet from the main entrance an air gallery, carried south on the face of the coal, is driven out to day. The ventilating furnace and air-shaft are located in the right of the second butt entry at the head of an old room near the coal outcrop.

A short distance west of this mine the Pittsburgh coal plunges under the bed of McMahon Creek, but reappears a mile west of Barnesville. There are a number of mines opened on the line of the Baltimore and Ohio Railroad, between Stewart and Mechanic's Mine and Barnesville, on the upper coals, but they are all "country banks," working a small force of miners on each for the supply of the neighborhood, and so do not come under the requirements of the mining law. The Pittsburgh coal, with its accompanying four-foot bed, lying eighty feet above, both of which are buried for many miles between Bellaire and Barnesville, are capable of supplying the State with coal from this district alone for several centuries.

Several of the mines below the village of Bellaire were visited and inspected, but several others, namely, the Weegee, the Union, and the Pipe Creek Mines, have not been examined during the year.

The Barnesville Shaft, operated by Messrs. Dawson & Roy, is the most westerly opening on the line of the Baltimore and Ohio Railroad, on the Pittsburgh seam of coal. The shaft, which is one hundred and eighty-six feet in depth, passes through three seams of coal. The strata encountered in sinking were mainly limestones. Near the bottom of the pit, a stratum of sandstone is present, which comes down within a foot of the coal, and in the main workings sometimes forms the immediate roof. Usually, however, the roof is in a gray shale, from one to ten feet in thickness. The coal seam is from four to five feet thick, and has no roof coal, as at Bellaire and Macksburg.

The coal from this shaft is used for local consumption—supplying the town of Barnesville and the surrounding country. Usually ten to twelve miners work in the mine during summer, and about double this force in winter. All the workings, so far, have been pushed on one side of the pit, but face and butt entries are now being driven on the other side, to develop that part of the mine. In laying out the mine, a strong, rectangular pillar was left at the bottom of the pit, for strength and safety. The double parting, on both sides of the pit, is laid with T iron, and this kind of rail is now being used in all the newer workings. On one side of the pit bottom, a passage-way is cut to allow people to pass from one side to the other without going through the shaft. The ventilating furnace is made secure by a thirty-foot arch, and a wall of stone built at the bottom of the upcast compartment of the shaft. The top of the pit is also very secure, the only access being through a door, which is kept shut, except during working hours. The miners are paid for both lump and nut coal (each variety being weighed in separte scales), and they are paid in cash at the end of every week. Double entries are driven in the mine, and the ventilation is kept good at all times. There is a proper place in the engine-house, with good soft and warm water, for the miners to wash after finishing work. The mine has but one means of ingress and egress, but it does not, and will not, for some time yet, come under the requirements of the law in this regard; less than fifteen hundred square yards have been excavated.

THE MAHONING VALLEY.

On the 18th of January I visited the Mineral Ridge mines of the Mahoning Valley, inspecting the Weathersfield Shaft, the Austin Shaft, the Cambria Shaft, the Ohltown Shaft, and the Thornton Mine. The latter is a drift opening, and the coal is hauled to day by the inside mules. The ventilation was by the natural forces, the mine having an upcast air-shaft, the workings were free from impure air, and in a fit state for the abode of the miner. Only twelve or fifteen men were at wo
mine.

One of the entries of the Cambria Mine was badl
orce of the miners were working close together

had no air-doors applied, and hence there was no return for the air. The miners were plunged in a thickening atmosphere of powder-smoke, and as this was the daily condition of the entry, the workmen had very properly named it "Smoky Hollow." I directed that the air should be carried forward to the face of the entry, so as to renew the circulation and keep the mine free from powder-smoke.

In the Ohltown Shaft there was also bad air in one of the entries, and several of the rooms were not in a fit condition for men to work. The entry itself had dipped under water, and was idle, and an air-course and hauling road was being pushed forward to get up the air and cut off the hill.

The Weathersfield Shaft was in better order than either the Cambria or Ohltown Mines, though the air-course, which followed the main entry, was further behind than was necessary, and I called the attention of the pit boss to the fact, and urged him to keep it abreast of the entry at all times.

The Austin Mine (Tod & Wells, shaft) was in much better condition in all its ventilating arrangements than any of the others.

On the 30th of July I again visited the Mineral Ridge mines, inspecting the Weathersfield Shaft, which I found defective in its ventilating arrangements. The amount of air flowing through the mine was less than four thousand feet, while the underground force exceeded one hundred men and boys. The air was also imperfectly distributed, little of the moving current reaching the miners, many of whom were working in an hourly thickening atmosphere.

Previous to this visit, the wooden structures covering the hoisting shaft had taken fire several times from the sparks emitted from the pumping-engine stalk. The mine had recently changed hands, and the new manager, Mr. Henry K. Wick, of Youngstown, immediately replaced the wooden roof of the hoisting and engine houses with a covering of sheet iron. As, however, there was no proper ventilation in the mine, and as the second opening had no proper means of egress for the escape of the miners in case of accident to the main shaft, complaint was made in court against the mine. The hearing was set for Tuesday, August 21; and in the interval the ventilation was improved by closing the leaks in faulty stoppings, erecting a number of air-doors, and shortening the distance the air had to travel in the mine. An iron ladder was also put in the air-shaft. Mr. Wick now claimed that he was complying with the law, and requested a discontinuance of legal proceedings. Desiring a legal decision as to the meaning of available means of ingress in the case of a second opening, and regarding the ventilalion as still defective, the case was heard before Judge E. B. Taylor, in Warren, on the day set for trial. The following testimony was given by the Inspector and miners working in the mine:

Andrew Roy, being first duly sworn, testified in substance as follows:

I am State Mine Inspector. I visited the Weathersfield Shaft yesterday. There were three hundred and ninety-two cubic feet of air per minute passing into the mine. In John P. Williams' entry three hundred and eighty-seven cubic feet per minute was flowing along the air-course. On that entry thirty-one miners were at work, of whom eight were ahead of the current; the others were outside of the current. In Richard Williams' entry four hundred and fifty cubic feet of air per minute was moving. Sixteen men were at work in this entry. I measured the currents of air in these entries before taking the volume going in the down-cast shaft. After measuring the main current going into the mine, I suggested to the mine boss that the fire in the ventilating furnace was perhaps low, and told him to go to the furnace and put in a good fire. I took four measurements after the fire was raised to its height: the first showed five thousand five hundred and seventy cubic feet per minute; the second, five thousand seven hundred and sixty; the third, six thousand and sixty; the fourth, five thousand seven hundred and fifty-five. These are the highest powers of the ventilating furnace. Mr. Perkins, the boss, informed me that upward of one hundred men were at work in the mine. I do not know the number myself. The full capacity of the furnace would move less than sixty cubic feet of air per minute per person employed.

There is no way to go to the bottom of the upcast shaft except by passing through the furnace fire. If the main shaft were to close, the miners could not escape through the upcast shaft so long as the fire was burning in the furnace; they would be cremated in attempting to pass through the fire. I put the fire out yesterday; the furnace took about half an hour to cool down so that men could pass through it. If the main shaft were to close, the fire might be put out, and the miners get up through ths second or upcast shaft; but if the main shaft buildings should take fire on top of the pit, they could not climb the ladder in the upcast with the fire burning in the furnace. In the winter season, the second shaft is used as a down-cast; in the summer, it is the upcast. It is filled with ice during winter.

I inspected the mine two or three weeks ago also. There was a marked improvement in the ventilation on the last visit, yesterday. A number of doors had been changed, causing the current to flow more directly towards the miners, and the stoppings had also been overhauled, and leaking places stopped. There are many places much better ventilated than others. The men who get the first of the air, get good air. Those places ahead of the current, or places where the current is allowed to leak and spill before reaching the miners, have bad air. Miners working on the return current have the worst air. The current becomes fouler every time it passes from one miner to another. The combustion of lamps, the exhalations from the lamp and body, the decomposition of wood and coal, and shale and pirites of iron, the blasting of powder, and the gases given off by the coal strata, contaminate the air. These impurities pass from one miner to another, and those who get the last of the air, get the foulest air. In bad air, that is, air charged with black damp, there is a blackness around the wick, the lamp is cold, and the light goes out easily. The effect of such an atmosphere on the miner is not direct; it m
weeks or months before he feels any bad effects. He gradually becom
spirits; he becomes stiff and sore, his bones ache; he becomes very
ready for a strike.

Cross-examined.—I measure the volumes of air by means of Biram's anemometer, made by Davis. It registers the speed of the current. The size of the main shaft is, I think, eighteen by nine feet. I measured the amount of air in the main entry, about fifty yards from the bottom of the shaft, where the whole current was passing into the mine along the entry. I measure the speed with which the current moves, then measure the sectional area of the gallery, and multiply the area by the speed with which the air moves in one minute. I could not measure air not in motion. The anemometer would not indicate any thing. I can calculate the amount of air not in motion in a given area by figures. To measure the amount of air passing through this court-room, I would take the amount of current coming in or passing out of the windows. We have to use other instruments to test the purity of the air. All the rooms and galleries of the mine are filled with air. It would take two hours for the current passing into the mine to traverse the air-courses and reach the upcast. The air in the abandoned or wrought out portions of the mine is usually stagnant. That is not measured. The amount of air in the mine is not considered in measuring the current, but only the amount going in or coming out. The size of the air-course where I measured the whole column was five by five and a half feet as measured by the bank boss. The ventilation could be increased by enlarging the furnace and the air-courses. I would take out the present furnace, which is only three and a half feet wide, and build one five and a half feet wide, and make it thirty to forty feet long, and build this furnace further down the return; cut off the water in the air-shaft by rings cut around the shaft, or line the shaft with brick; enlarge the air-ways to thirty feet of area; drive double entries, and do away with doors or rooms, and build a stalk on top of the air-shaft forty feet high. There is no doubt, whatever, of the possibility of moving more air in the mine. With proper arrangements, you could move one hundred thousand cubic feet per minute. These are matters well understood by mining engineers, and two hundred thousand to two hundred and fifty thousand cubic feet of air per minute are now in circulation in some coal mines.

The furnace is located at the bottom of the air-shaft. There could be a way cut to get to the bottom of the shaft without passing through the furnace. There is no such way now. If the fire was burning in the furnace, I do not think that men climbing up the ladder of the air-shaft would be suffocated by the gases before reaching the top. If the circulation of air was cut off, the fire would not draw, and it would soon go out. If the main shaft buildings were to take fire, the main shaft would become the upcast, the ventilation reversing as soon as the greater heat became transferred to that shaft. Mr. Perkins has constructed a door which, when shut, causes the air to flow direct from the down-cast or main shaft to the up-cast. In case of fire, if this door was shut, the smoke and gases from the fire could not pass into the workings of the mine.

Elias Lewis, being first duly sworn, on the part of the State testified in substance as follows:

I have lived in Weathersfield since 1865. I am a miner. I work in the Weathersfield Shaft. I have worked there about two months. This is the mine that this action is commenced against. Richard Perkins is the bank boss. The air is furnished by a furnace and an air-shaft. I do not know how deep the air-shaft is, but think about one hundred and seven feet. The main shaft is one hundred and eighty feet deep. I never measured them myself. The furnace that furnishes air is placed at the bottom of the second shaft, or what is called the air-shaft. I have not seen that furnace for some years. I do not know how it is now. I was in the bank yesterday. The air was poor. You could not carry a light around without its going out. I know nothing about it only where I was. I never made any measurements of the air in the bank myself. I saw Mr Roy making measurements. I know nothing about the result. The air is bad, for the light burns very dimly. If the air is good, the light burns clear, and no black cap on the wick. It has been bad ever since I have been there. The air would be nearly the same each day with the same ventilation. In case the first shaft should be closed, you could not escape through the second one. The draft would cease when the first shaft was closed and you could not pass through the fire in the furnace to get to the second one.

Cross-examined.—I worked nearly at the far end of the mine, in what is called Williams' entry. I work in a room. I should think it was a half a mile from the entrance to where I work My room is about twenty yards from Williams' entry. I commenced to work there in May last, and have worked there continuously as a miner since. I worked there yesterday. I have worked across the entry in another room not quite as far in as the one I work in now. I have not heard any complaint made to Mr. Wick about the air. The air is not very good. There is difficulty in breathing it. I dig three tons per day. It is not a very good day's work. We ought to dig about four and a half tons each man. The coal is about four and a half or five feet thick. It has a bone in the center of it. I have averaged about a ton a day since I commenced. The air in the second room was the same. I discovered that the air was bad by the lamp. I use a common mining lamp. The lamp burnt dim. I never made any complaint to the bank boss at the time. Richard Perkins is the bank boss. I see him nearly every day. I worked there yesterday. I did not make any complaint to Mr. Roy. I made no complaint in writing. There has been change in the air since I commenced working there. It commenced to get better the first of last week. It has not been any better since. During the last of last week it ceased to get better. It was in a better condition last week than before. I know that there have been improvements made. I have not seen that fire arrangement for six or seven years. I have not made any effort to go up or down that ladder in the second shaft.

By the Court.—I mean it would be impossible to go up it if the first shaft were closed, but it might be possible to go up it now.

Re direct.—If both shafts were open, and the fire should go out, there would be no ventilation. The ventilation was improved the first of last week. The means used was by changing doors.

Re-cross-examination.—I have been a coal miner since I was sixteen years of age. With all the plans used for ventilation in operation in some of the far rooms the air will be bad unless means are taken to drive air to it. I do not know that it is the custom for miners to bring the attention of the boss to it. Of course the miner is the first to know of the bad condition of the air, and he would probably complain of it. The bank can be ventilated so that the air will be good. There are other rooms more remote than mine.

John Morgan, being first duly sworn on the part of the State, testified in substance as follows:

I live in Weathersfield. I am a miner; have been a miner since I was thirteen years of age. I commenced working in this mine in the latter part of June. I work in James Packard's entry. We get the first air that comes to the bank. I worked there yesterday. The air was "dogy" yesterday. There has been considerable improvement in the air; it commenced seven or nine days ago. The air yesterday was considerably duller; it was not good, but what the miners term middling. I could work in it without any difficulty from breathing. I was only in my own place. I do not know how many men are employed, but I suppose about a hundred. I did not see any measurements made yesterday. I should think it was about seven hundred yards from one opening to the other. I have never seen the second shaft; I do not know how it is constructed. In case the first shaft should fall in or get on fire, I consider it would be impossible to get out—under some circumstances it could be done; sometimes there would be no draft of air, and it would be a long time before they could get out. If the ventilation should entirely cease, the fire might be put out; the men might possibly get out and possibly not. The ladder was put down yesterday.

Cross-examination.—The ladder was completed yesterday; it is an iron ladder. I know that you could not get through fire to get out. I know there is no means of getting around the fire, only by hearsay. The fire was put out a part of the day yesterday, to put in the ladder.

Re-direct.—The air was bad all day yesterday.

Andrew Roy was recalled on part of the State to show and explain the manner of using the anemometer, showing the instrument, and testified:

This is an anemometer, the latest and best instrument of the kind, used by the best mining engineers for measuring the volume of air. For every revolution of the index hand one hundred feet of air passes.

Thomas Gwynn, being first duly sworn on the part of the State, testified, in substance, as follows:

I am a coal digger; I have been one for fifty years. I work in the Weathersfield Shaft. I have worked there about two months this last time. I work in the part called the John P. Williams' entry. It is the second entry from where the air comes in. The air should be as good there as anywhere in the bank. I was working there yesterday. I did not find any difference in the air yesterday from the day before. The air is better there now than it was when Roy was there before. I work in the windway. The air in the bank yesterday was not what it ought to be, but I could get along where I was. I worked yesterday from 7 in the morning until 4 in the afternoon. I did not see any difference in the air yesterday where I was working. I did not know that the fire was out yesterday. I saw no difference in the air. I do not know whether I ever saw the furnace. I know nothing about the ladder.

William Leyshon, being first duly sworn, on the part of the State testified in substance as follows:

I am a coal-miner. I have worked in this bank since last fall. I worked inside yesterday. The ladder was put in yesterday. It is a wire rope, with iron rungs. It is fastened at the top and bottom. Any one can walk up it. The furnace is built with an arch. It is not all arched over. When I was there a man could not get to the ladder when the fire was in. It takes, I suppose, about four hundred to five hundred pounds of coal on it to keep the draft up. I do not say a man can not get out the shaft, but there are plenty of men that can not get up there. It is one hundred and seven feet high. There are about one hundred men in the bank. I should think it would take three minutes to get out. The ladder is strong enough to hold all the men if they could get on to it. It is fast to a log—in the center, at the top—about seven inches in diameter. There was Michael Finn went down it. I was in the bank yesterday. The air was about the same as usual. It is not very good usually. I think that there ought to be more there. I was in the first entry yesterday. The air would be the best there of anywhere. The air there was middling—about half and half. I was probably one hundred yards from the entry yesterday. I think that Lewis is in the farthest place in the bank. There is no man can go near the second shaft in the winter for the water that goes down it.

Cross-examination.—The ladder was not there in the winter. I believe I could get up it by taking a rest. I do not consider it safe. There ought to be some place to rest. I do not believe I could climb it without a rest. You can not get to the ladder without going through fire. The furnace is about twenty feet from the shaft. You can pass right in front of the fire to get to the ladder. You would have to come from the furnace. The coal is put in at the front of the furnace. I think one could push through the side of the flue. I think that one at a time could get through from the side of the flue to the entry; he would have to go through sideways. There is some dirt thrown in there. The entry is dug out considerably beyond that. The side of the furnace can be cleaned out.

James Parfit, being first duly sworn, on the part of the State, testified in substance as follows:

I am a miner in the Weathersfield Shaft, and have been for nine years. I worked there yesterday. I worked in the far end. It is pretty near in the face of the main entry. I am about fifty yards from the main entry. One man works with me. The air was a little dull yesterday. The light burned a little dull. It was a little better last week. It was worse yesterday than last week.. The air yesterday was bad. I was in the bank from seven in the morning until four in the afternoon. I have not been at the second opening for three years. I have not seen the furnace for three years.

Cross-examination.—The air was some better last week than yesterday. The air was bad yesterday; do not know the cause of it. I had no difficulty, and made no complaint about it. Elias Lewis works with me. I have worked there nine or ten years—ever since the bank worked. The air is a great deal better than it has been at any time before. It was not as good yesterday. I did not know that the furnace was stopped yesterday.

Re-direct.—The air was the worst about ten o'clock. It was about the same when we quit. I do not know what time the furnace was stopped.

John W. Evans, being first duly sworn, testified in substance as follows, on the part of the State:

I am a miner in the Weathersfield Shaft. I have been there nine or ten years. I work in Maddock's entry. The air was not very good or very bad yesterday. It has been very bad before. It was worse three weeks ago than since. They have been fixing the doors and stopping up the crevices. It was soon after Mr. Roy was there. I never was at the bottom of the shaft. I have been up as far as the flue. I have not been there for five or six years. There are several that work farther than I have. I was only where I worked yesterday.

Cross-examination.—I think Mr. Wick commenced working the bank about the 15th - 16th of July last. Soon after that the air began to get better. Mr. Perkins is the ir boss. The air is better some days than others. It is always better some de- others in every bank. I made no complaint about it. I heard them say ye were going to stop the furnace. I work in what is called the Tod coal. I commenced there when Mr. Wick commenced. When I commenced I could not go up where I work half the time for bad air.

John E. Davis, being first duly sworn, on the part of the State, testified in substance as follows:

I am a miner in the Weathersfield bank; work near the far end of the bank, about twenty-five yards from the main entry. There are some that work farther away than I do. My boy works with me. Yesterday, the air was not very bad until about dinner time; then it was worse; about one o'clock the lamp would not burn very well; from one until four it was bad. The lamp did not burn very good after one o'clock. Before one o'clock it burnt very good. The improvements commenced soon after Mr. Wick took the bank, about nine or ten days ago. I never was at the bottom of the second shaft; have not seen the ladder since it was put down.

Cross-examined.—About one o'clock the air got bad. I worked until after four in the afternoon. I did not know at what time the fire was out. That would stop the circulation.

Plaintiff rested thus far on the issues.

Richard Perkins, being first duly sworn, on the part of the defense, testified in substance as follows:

I am the inside boss at the Weathersfield bank. I commenced a year ago last February. I continued right along after Mr. Wick took possession. I worked there before for the Liberty Coal Company. Since Mr. Wick came there, Mr. Roy came in and found fault with the air. Before this there were complaints made by the men—some of them. After Roy came there, I went away back to the big shaft, and wherever I found any obstacles I cut them away, and it acted first-rate for ventilation, and I have continued it right along since then. Mr. Wick told me to do the best I could for the circulation. I put in the ladder. The fire would have to be put out to get to the ladder. I could fix it in a couple of hours, so that one could get to the ladder without going through the fire; could now go over the furnace. I think the fire is about thirty feet from the shaft. We drew the fire yesterday, when we put in the ladder. We could go through in half an hour after the fire was drawn. I think, in case of necessity, a man could go through there in fifteen minutes after the fire was drawn. I am going to put in a stage to rest on, going up the ladder. To do this, we have to cut holes in the side of the shaft, and put scantling in, and then put plank on.

Cross-examined.—If staging were put in, it would obstruct the ventilation a little. I should put in three-inch scantling. The size of the second shaft, I think, is seven feet by five. It is 107 feet in depth. One could go over the top of the furnace when there was no fire in it; could go over it quicker than through it, after the fire was drawn. There is about two feet space over the furnace. There is no other way to get through, now. I have worked in a bank all my life. I have never been in a bank when an accident occurred. If the roof should fall in, I think a man could get out by putting out the fire. It would not take more than fifteen minutes. There would be no draft at all if the other shaft were closed. I do not know whether anybody could get out in case the other shaft got on fire; the draft would then come down the small one and up the large one. The men used to make complaints about the bad air; I do not remember about its being made yesterday. It was after Mr. Roy came there that these improve ments were made. I do not remember of there being any complaints about bad air since Wick come in there.

Re-direct.—There is a tin roof on the house over the main shaft, and hose attached to the pump to put out fire. I do not think the staging in the second shaft would be any hindrance to ventilation.

After the hearing of the testimony, Mr. Wick expressed a desire to cause any further improvements to be made which I should deem necessary, rather than have the Judge decide the case. Accordingly, I wrote the following memorandum, and sent it to Mr. Wick:

OFFICE OF THE STATE INSPECTOR OF MINES,
COLUMBUS, O., *August* 22, 1877.

HENRY K. WICK, *Esq., Youngstown, Ohio:*

DEAR SIR—The following embrace the improvements required in the Weathersfield shaft:

1. The water falling in the air-shaft to be led by a ring cut around the shaft into a pipe, and discharged at the bottom of the shaft.
2. A partition to be placed in the air-shaft, from top to bottom—the lower thirty feet to be of brick, and the up-cast compartment to be at least twenty feet of sectional area at the smallest point, and a stalk twenty-five feet high to be placed on top of shaft.
3. A new furnace to be built at the bottom of the air-shaft; said furnace to be five and a half feet wide, three and a half feet above the bars, two feet below the bars, and thirty feet long; the rear end to reach back to the up-cast compartment of the air-shaft, and the present furnace taken out.
4. All air-ways in the mine to have a sectional area of at least twenty-five feet at the narrowest points, and no miners to be employed ahead of any air-way, except entrymen and the workmen breaking off the inmost room; all miners now working ahead of the air, otherwise than stated above, to be removed until the air-ways are got up.
5. A thorough overhauling of all air-courses, and all leakages to be effectually sealed up.
6. A passage-way to the foot of the ladder, without having to pass alongside of or over the furnace.
7. Work on the above improvements to be commenced on Monday, August 27, and to be completed on Monday, October 1, 1877.

Yours, very truly,
ANDREW ROY, *State Inspector of Mines.*

The ventilation in this mine was forthwith improved, a corps of day men being put to work enlarging air-ways, building stoppings, and stopping leakages of air at doors and stoppings, but the partition was not put in the shaft. As the partition was likely to be made the subject of legal inquiry, the mine owners deeming its use unnecessary, I concluded to have the judgment of the courts in regard to the meaning of the statute before insisting further against this mine.

Last year a tunnel, nearly a mile in length, was cut in the rock underlying the coal, into the mine of the Brookfield Coal Company, situate in

Trumbull county, for the purpose of cutting off the slope, the incline plane leading to the chutes, shortening the hauling roads inside and outside of the mine, and discharging the water by gravitation. A description of this tunnel, and its advantages to the mine, were given in my last annual report. At the interior end of the tunnel, where it went through on the coal, a double parting was made, at which point the trains from the mine workings were made up be to hauled through the tunnel to the chutes outside.

On the 5th of July of the present year, the horses used for hauling the coal through the tunnel were taken off, and a mine locomotive six feet high, weighing nine hundred pounds, with six by ten cylinders, was substituted. Two trap-doors were erected in the tunnel, one near each end, in order that while one door would be open to allow the engine and cars to pass to and fro, the other would be shut, and thus prevent the smoke and gases made by the engine from passing into the workings where the miners were employed digging and loading the coal; but no provision whatever was made for carrying away the smoke and gases in the tunnel itself. The mine locomotive, which was used all day on the 5th of July, filled the tunnel with smoke and carbonic acid gas to such an extent that towards evening the lights went out even when moved with caution, and the engineer and brakeman were well-nigh overcome from the effects of the poisoned atmosphere. Next day an effort was made to use coke as fuel, but steam could not be kept up, and the locomotive was withdrawn and the hauling horses put in the tunnel. On the 11th, anthracite coal was tried, and four trips were made in the forenoon of that day. The fire-box of the locomotive, constructed for the use of bituminous coal, burned anthracite very imperfectly, resulting in the formation of an unusual amount of carbonic oxide, this gas being very much more deleterious than the carbonic acid.

On the third trip the trapper boy—a lad sixteen years of age, who was attending the interior door—left his work and went home, his father, in the morning, having charged him to leave the tunnel as soon as he began to feel any bad effects of the gas.

The engineer, on coming out with the third trip, reported to the mine boss, Mr. John Jones, that the trapper had left his door, and that the gases from the mine locomotive were becoming very strong.

Mr. Jones then went into the tunnel to attend the door himself, with the purpose of making one more trip, and if he found the gases too strong, he intended taking out the engine and again substituting horses.

As the engineer passed the door on the ingoing fourth trip, he saw Jones in attendance; but, on coming out, Jones was not seen, and the engineer, supposing the boss had gone out in advance of the train, did not stop. On coming outside, however, Jones was not there, and the brakeman, who was on the rear end of the train when it started out, was also missing, and the engineer himself was scarcely able to stand up.

The engineer immediately gave the alarm, and two miners, William Roberts and Miles Davis, got their lamps and rushed through the tunnel in search of the missing brakeman and boss. Before these men had gone one thousand yards in the tunnel, Davis fell, overcome with the gas. Roberts raised Davis on his back, and carried him forward for nearly one hundred yards, when, becoming weak and faint, he laid him down and went forward alone. Roberts, unwilling to leave Davis behind, after advancing one hundred feet or so alone, returned for Davis, and again tried to raise and carry him, but he was too weak, and was forced to abandon his dying comrade. Roberts passed both the brakeman and the mine boss, who were stretched full length on the floor of the tunnel, but could offer them no assistance. He continued forward, hoping to reach the hauling roads beyond the double parting, where the driver boys of the mine were at work hauling coal, but had not passed Jones many yards when he also fell, overcome by the poisoned atmosphere of the tunnel.

Meantime, some of the driver boys at the double parting, inside of the tunnel, saw Roberts fall; and, feeling the noxious influence of the spreading gas upon their own lungs, one of their number ran back to the nearest working places of the miners, and told the workmen that men were falling in the tunnel from the effects of the gases of the mine locomotive.

Three of the miners—Thomas E. Thomas, Samuel Jones, and Evan J. Evans—immediately ran out to the double parting, thence into the tunnel, and, coming upon Roberts, lifted and carried him back into the mine, beyond the influence of the poisoned atmosphere. Soon after reaching the fresh air Roberts became sensible.

The three miners again went back into the tunnel, taking an empty car with them. They found Jones, the boss, at the trap-door, and, lifting him into the car, brought him back into the fresh air, but he was dead. Miles Davis was next recovered. He was still alive, but died in half an hour.

The tunnel was now clear of both the dead and dying; but the rescuing miners were not aware of the fact, and they again went into the tunnel in search of other comrades, taking the empty car along. They passed through the tunnel, coming out to day without encountering any other victims of the deadly gases, and, fortunately, without any of the party falling by the way, the grade of the tunnel, which dipped one foot in every fifty, facilitating their passage through to day.

As soon as the alarm spread through the mine that men were falling in the tunnel, one of the driver boys made his way out of the mine by the old slope, and mounting his mule, rode over to the Cleveland Shaft, an adjoining mine one and one-half miles west of the Brookfield Mine, and implored the miners to come to the Brookfield Mine with all possible dispatch, for men were falling and dying in the tunnel. The mine boss of the Cleveland Shaft, Mr. William Meredith, hitched up a team, and with a wagon load of miners rushed over to the Brookfield tunnel. The Cleveland Shaft miners arrived about half-past twelve or one o'clock, by which time the tunnel had been cleared and the passage made through it by the three miners, Thomas, Jones, and Evans. This fact the Cleveland Shaft miners did not know, and they had no sooner reached the tunnel mouth than three of the number rushed inside, four others following with an empty car. One of the three waited for the car to come up, but the other two, David Jenkings and Richard Jones, moved forward alone, and after advancing about one thousand yards, fell and died. The second party, with the empty car, only advanced about seven or eight yards, when, some of the older men complaining of weakness, all jumped in the car and let it run back to the tunnel mouth.

Meantime, news of the disaster had reached the Applegate Mine, situated one and one-half miles south-west of the tunnel mouth, and while David Jenkings and Richard Jones were still in the tunnel, a rescuing party of miners from the Applegate Mine arrived. A corps of volunteers from this mine went in to rescue Jenkings and Jones, and two of the party, John Barter and John Young, fell and died. A number of others fell, but were rescued and recovered. The miners who sought to rescue their fellows in the tunnel displayed a courage and disregard of self never surpassed on any battle-field. No sooner was one party stricken down by the deadly gases than others were ready and eager to attempt their rescue. Even when all were got out, both those who were dead and those who were stricken down senseless, men were eager to go in the tunnel to search for comrades who might possibly be inside still.

I was in the Leetonia mining district when this accident took place, and did not hear of its occurrence until four o'clock the following evening. The Brookfield Coal Company telegraphed me at Columbus on the morning after the accident, and learning I was at Leetonia, dispatched for me there also. The dispatch reached me too late for the train, and on arriving at the mines at noon on the 13th, I learned that the coroner's inquest had been held, and the jury adjourned on the 12th. Desirous of having all the facts brought to light, I addressed the coroner of the county the following letter, requesting a reopening of the inquest:

BROOKFIELD SLOPE, OHIO, *July* 13, 1877.

CORONER EWALT, *Howland, Ohio* :

DEAR SIR: I regret exceedingly that after viewing the bodies the inquest was not adjourned until after my arrival, in the case of the late Brookfield Slope catastrophe. If it can be done, I desire to have the jury meet again, and the inquest reopened.

Please address . e at Columbus, Ohio, as to whether this will be done.

Very truly, etc.,

ANDREW ROY, *State Mine Inspector.*

The following is the coroner's reply:

HOWLAND, *July* 18, 1877.

MR. ANDREW ROY, *Inspector of Mines* :

DEAR SIR: I did not receive your note of the 13th until yesterday, the 17th. I then had my report all made out. I went to Warren to-day and consulted with the Auditor and Prosecutor, and have come to the conclusion not to call the jury together again, as I can not see as there is any thing can be obtained by it that we have not already got. Am sorry that you did not telegraph when you got the word, as I should have been very glad to have had your experience in the investigation of the matter.

Yours truly, in haste,

Z. T. EWALT, *Coroner of Trumbull County, Ohio.*

HOWLAND, *July* 18, 1877.

ANDREW ROY, *Inspector of Mines* :

SIR: I certify the following papers to be a true copy of the proceedings had by me on the dead bodies of John Jones, and others, in the late Brookfield disaster, of which proceedings I have returned to the Clerk of the Court of Common Pleas:

Coroner's fees	$34 60
Jury	12 00
Witnesses	8 25
Constable	4 75
Notifying coroner	2 00
	$61 60

Given under my hand and seal, this 18th July, A.D. 1877.

Z. T. EWALT, *Coroner.*

The State of Ohio, Brookfield Township, Trumbull County, ss.

An inquest by the undersigned jury, duly impaneled and sworn, was held on the 12th day of July, in the year A. D. 1877, in the school-house in south-east part of said township, over the dead bodies of John Jones 2d, Miles Davis, Robert R. Williams, Richard Jones, David Jenkings, John Barter, John Young, who were supposed to have come to their death by violence. The undersigned, Z. T. Ewalt, coroner of said county.

The following is the testimony of the witnesses then and there examined before said coroner and jury, and which was then and there reduced to writing in pursuance of the statute in such case made and provided:

TESTIMONY OF THOMAS E. THOMAS.

Thomas E. Thomas, being duly sworn, says: I reside in Brookfield township. I am a miner. I went into the tunnel and learned that there was something the matter; went to the double postern, went to the door with Mr. Mazey; saw Mr. Jones, he had fallen head-down in the ditch. Mazey got hold of him first; I then took hold of him, and we put him in the car, and pushed it to the bottom of slope. I did not go to end of tunnel any more; think it was about 11 A. M.

TESTIMONY OF ALFRED LANDIS.

Alfred Landis, being duly sworn, says he is a resident of Brookfield township at present time—his home is in Harrisburg, Pa. I am an engineer on the shifter at the Brookfield tunnel. John Evans and I went into tunnel at about ten minutes of eleven o'clock. I was about 150 or 200 yards in the tunnel, and told John to tell Jones that I could not stand it any longer, and tell him at the door in passing. Jones was trapping; said we should wait till we came back and I will tell him. In passing the door I saw Jones standing on the right hand of door with his lamp on his head; went on into the double, took hold of our train—the door is about 150 or 175 yards from the parting—came on this very train out of the tunnel; went very slow, waiting for Jones; passed on down; did not see Jones or his light; my light had gone out; missed Jack about 100 yards from door; kept on going until I got outside; looked for Jack, expected he would be on hind part of train, was not there. I raised the alarm that Jones and Jack had fell in the tunnel. Miles Davis, H. Roberts, Charles Robbins went in. It was about fifteen minutes after eleven when we started in; did not see Davis until evening, he was dead; wanted to go in right away, but they would not let me go. I did go in about three o'clock. The cause of the trouble was sulphur, it was in a vapor in the tunnel—Friday of last week run a whole day; the smoke was bad then. Jack gave out about four o'clock P. M. Myself and William Roberts took his place. Much of the cause was from the vapor rising from the coal used as fuel for the engine; think the tunnel had not draft enough; was using the anthracite coal by the order of Jones, the superintendent of the mine; had used coke, but could not keep up steam with it. Jones asked me if I ever knew of the burning of hard coal in shifters used in the mines. I told him I did; have been in mines and saw it used; think the accident was caused on account of there not being a sufficient draft in the tunnel; have run engine for four years.

TESTIMONY OF WILLIAM REDFORD.

William Redford, being duly sworn, says he lives in Brookfield township; is a miner by occupation. A boy came and told us that there were men falling in the tunnel. Went out, saw William Roberts, been taken out, laid on side of tunnel in the inside of the mine; saw Daniel Davis taken from the same place in the tunnel; saw John Evans after he was brought out of the tunnel; saw William Williams brought out. Four of us then took a car and went into the tunnel, and thought to pick up others that might have fallen. There were four other men followed us; saw Robert Williams about half way from the parting to the outside; he was lying on his back, dead; took him into the car, went on about 150 yards, saw the engineer lying down, put him into the car—think it was about ten o'clock A. M.; came to Evan Hopkins, and he came out in same car; came through to the outside of tunnel; have been very sick—are not usually troubled with those gases in the mines.

TESTIMONY OF JOSEPH JONES.

Joseph Jones, being duly sworn, says: I live in Brookfield township, am a miner by occupation. A little boy came and told that Jones and William Roberts were killed in the tunnel. Then we went in, met cars coming out with men in them; think Jones was in one of the cars, dead; then went through from the inside of the mine, through the tunnel, to the outside; was about twenty minutes going through; felt good; came out, think it was, 1.30 P. M. The men did not push the car. Reymon was ahead of the car, about half way out of the tunnel he fell into the car.

TESTIMONY OF JOHN REYMON.

John Reyman, sworn. Reside in Brookfield; am a miner by occupation; work in the Brookfield bank. Was at my work; saw a boy coming out; said he wanted help, that Wm. Roberts had dropped dead in the tunnel. I went to the tunnel; met Wm. Roberts carried by some persons; think it was about fifteen minutes to eleven o'clock. I took hold and helped to carry him into the works, to a place where there was a little fresh air. Hardly knew whether he was dead or alive. Worked with him for five or eight minutes. Heard another call from the tunnel for help; went back to the tunnel; passed a car with Mr. Jones in it. He lay flat in the car; think he was dead; were some sitting in the car; could not tell who. Came towards the outside; met some men carrying Miles Davis; helped to carry Mr. Davis to the inside of the tunnel, where he could have fresh air. Came through the tunnel to the outside.

TESTIMONY OF J. E. STEWART, M.D.

J. E. Stewart, sworn. Think it was about two o'clock; the men were prostrated from breathing air destitute of oxygen, and think that was the cause of the death of John Jones, Miles Davis, Robert R. Williams, Richard Jones, David Jenkings, John Barter, and John Young.

TESTIMONY OF BENJAMIN EDWARDS.

Benjamin Edwards, sworn. I reside in Brookfield; am a miner. Boy said there were three or four men in the tunnel. I went to the tunnel; found Wm. Roberts brought out to Jones' entry. Saw Miles Davis; think there was life in him at the time, 11 A.M. Went into tunnel; saw John Evans, and William Williams laying on his side. Came back to Jones' entry, then went with a car out to the mouth of the tunnel. Found Robert Williams; then came to the engineer; do not recollect anything after for quite a while Think there was some gas in the bank; cannot say how far in it extended.

TESTIMONY OF M. J. M'ELHANY, M.D.

M. J. McElhany, sworn. I reside in Brookfield, and practice medicine there. A messenger came for me a few minutes before 12 M.; said there was a number of men smothering to death in the tunnel, and for me to come to John Jones 2d as fast as possible, as he was afraid he would be dead before he got there. Before I got to Jones, met a boy on the mine; said need not go to Jones, he was dead, but go to the slope. I found men there ready to conduct me into the mine. When I got to the bottom of the slope, there were two men in the car; Danl. Davis was in that car, but so far recovered that he did not want any medical assistance—could get along by getting to the fresh air. Miles Davis was in the same car, dead—had been dead twenty or thirty minutes. Went further into the bank, but turned back, for they were coming with some of the men in a car. They were Wm. Roberts, J. L. Evans, with some others that did not want any assistance. Gave our attention to Roberts and Evans; they were in what we term an asphyxia state; they were both insensible; they rallied in the course of an hour. Was called to the tunnel about two o'clock P.M. They said some men had went in to see if here were any more men in the tunnel. Six men were carried out of the tunnel, three of them already dead, and the other three entirely unconscious. Remained there about one hour and a half. Have not had any experience in the burning of hard coal. Do not know whose orders it was to use anthracite coal. I think those men came to their death from the effects of those poisonous gases.

TESTIMONY OF J. E. STEWART, M.D.

J. E. Stewart, sworn. Reside in Brookfield, and practice medicine there. Was called yesterday, in haste; that an accident had occurred at the tunnel, and wished me to go there as soon as possible. Got there; went to the old slope, then went down into the mine to see the men. At the foot of slope found D. E. Davis so comfortable that he did not need immediate attention. Went some distance; met another car, with a man in a prostrate condition; went on still further into the mine; met another car, containing a man who was considerably prostrated. Had the men brought out of the mine, where restoratives could be more readily applied, and was applied, and as soon as the men were partially restored, they were carried to the houses and cared for. Went back to the tunnel; saw six men brought out, three of them already dead, and the other three in a very prostrate condition.

TESTIMONY OF E. J. EVANS.

Evan J. Evans sworn, says he resides in Brookfield, is a miner by occupation; was told there was trouble in the tunnel.

Question. How far did this gas extend into the mine?

Answer. It extended to the door of the entry. When I am walking, the distance is about two hundred yards from the mouth of the tunnel, inside the opening of the door, to the entry where I work; would not have any effect to lessen or increase the amount of gaseous vapors.

We, the undersigned jurors, impaneled and sworn on the 11th day of July, A.D. 1877, at the township of Brookfield, county of Trumbull, by Z. T. Ewalt, coroner of said county of Trumbull, to inquire, and a true presentment make, in what manner and by whom John Jones 2d, Miles Davis, Robert R. Williams, Richard Jones, David Jenkings, John Barter, John Young, whose bodies were found in the tunnel leading into the Brookfield Coal Company's mine, after hearing the evidence and examined the bodies, we do find that the deceased came to their death by noxious and poisonous gases, generated by burning anthracite coal in the shifter used to coal from the inside of the said Brookfield Coal Company's mine.

HENRY HAMILTON,
JAMES DUNKERBY,
E. S. DAVIS,
THOMAS RODERICK,
His
DANIEL + DAVIS,
mark.
GEORGE STANFIELD.

Given under my hand and seal, this 12th day of July, A.D. 1877.

[SEAL.] Z. T. EWALT, *Coroner.*

A few days after the occurrence of the accident the Coal Company made proposals to the widows and heirs-at-law of the deceased, which were accepted. The widows, whose husbands wrought in adjoining mines, were treated the same as those whose husbands belonged to the mine where the accident occurred. The Coal Company deserves credit for the prompt manner with which the present wants of the poor widows and orphan children were relieved.

The accident at the Brookfield Mine can admit of no possible excuse; there was no provision whatever made for renewing the air of the tunnel. I visited the mine a few months before the completion of the tunnel, and a few weeks after it was finished. On my last visit the mine boss, Mr. John Jones, told me they had made up their minds not to put in a locomotive at all, as the timbers of the tunnel were in some places only 1½ inches higher than the locomotive, and that if it were to go off the track at those places they would never get it on again. At this time the air in the Evans and Hughes' entries was bad, owing to the removal of part of the ventilative powers from the upcast shaft; and Mr. Jones told me they would sink an air-shaft in a short time, and promised to advise with me in regard to its best location, whether the locomotive was used or not.

The mine started up again on the Monday following the accident, the locomotive being thrown aside and horses employed to remove the coal through the tunnel. Shortly after this, I learned that an air-shaft had been located near the mouth of the tunnel, to be thirty-six feet deep, and that on its completion the locomotive would be again used. I immediately visited the mine; and, learning that the proposed shaft had been let by contract, and was about to be started, I wrote the Coal Company the following letter:

BROOKFIELD SLOPE, *August* 18, 1877.

Brookfield Coal Company, Sharon, Pa.:

GENTLEMEN—I visited the Brookfield Slope to-day and noted the location of an air-shaft (to be thirty-six feet deep) near the mouth of the tunnel, with the object of using the mine locomotive again. This shaft, in my judgment, is very unwisely located, and will not serve the purpose in view. The air-shaft should be sunk at the interior of the tunnel, where it will be deeper, and be on higher ground both outside and inside—important considerations, under the circumstances, for increasing the power of the ventilating furnace. You may have here also two furnaces to this air-shaft: one fronting the mine workings and the other the tunnel mouth, and thus move two columns of air at once. Where you now propose sinking you can not move five thousand feet of air per minute through the tunnel, no matter what kind of a furnace you construct, and this amount of wind is not sufficient for the sanitary requirements of the tunnel with the mine locomotive at work. During winter weather, also, I believe the ventilation in the shaft will sometimes reverse itself, and the smoke and gases from the furnace instead of going up the shaft, will spread through the tunnel.

Since the completion of the tunnel the working places of the miners have, in the Evans and Hughes' entries, been poorly ventilated, owing to the removal of the ven ating power from the upcast shaft. A five and a half foot furnace should be built at the bottom of this shaft to heat the air to the point it was formerly heated when the pumping machinery were located there. This should have been done long ago, or another air shaft sunk at the interior of the mine workings, and the furnace placed there.

My main object, however, in writing this note is to call attention to the necessity of choosing a better location for the air-shaft of the tunnel, as I believe that the present plan, if persisted in, will result in loss of life before the spring of next year; and before you proceed further, I would be pleased to hear from you on this subject. Please address me at Columbus.

Very truly, ANDREW ROY.

To this letter no reply was received, and work was commenced on the proposed air-shaft, with the object of placing an ordinary sized furnace at the bottom of the pit, and of erecting a stalk on top, this stalk having a diameter of only three and a half feet. To have moved twenty-five thousand cubic feet of air per minute through this stalk would have required the column of wind to travel at the rate of twenty-eight and one-third miles per hour, a rate of speed which has never been reached in any air-shaft in the United States, or in the world, and which no furnace-power, under the circumstances, could have made possible of attainment. When all the conditions were considered, I became satisfied, after an examination of facts, that not more than four thousand cubic feet of air per minute could be moved through the tunnel by the proposed air-draft and furnace, which, as this gallery had an average sectional area of fifty feet, would give a motion to the air of only eighty feet per minute, or less than a mile per hour. The Briar Hill coal shows, by the analyses made by the State Geological Survey, a composition of—

Carbon	77.88	per cent.
Hydrogen	6.56	"
Nitrogen	1.51	"
Oxygen	10.57	"
Sulphur	0.64	"
Ash	2.84	"

In complete combustion the coal forms, in every pound—

Carbonic acid	24.53	cubic feet.
Vapor of water	11.80	"
Unchanged nitrogen	0.20	"
Oxygen	1.14	"

Making a total gaseous product of 37.65 cubic feet. Taking the carbonic acid produced by combustion, namely, 24.53 cubic feet per pound, as the only deleterious gas formed, the products of the combustion of a ton of coal would be the formation of 49,060 cubic feet of carbonic acid gas. One-tenth of one per cent. of this gas, in air, according to the chemists, produces headache and depression of spirits, while one per cent. is quite intolerable for even a few minutes. As the air in the tunnel, moving at the rate of eighty feet per minute, would not be changed in less than one hour, during which time the mine locomotive would make three round trips, depositing three thousand cubic feet of carbonic acid gas among two hundred and forty thousand cubic feet of air, the carbonic acid forming one-eightieth of the whole volume of the air of the tunnel, or one and one-fourth per cent., the slow but sure destruction of the health of those compelled to pass their working hours in the tunnel would be as certain as any problem in mathematics. Moreover, when the air stagnated, or reversed, as it would do in the winter if the furnaces were neglected, a renewal of the Brookfield horror was simply a question of time.

The parties in charge of the ventilating arrangements of the mine were life-long practical miners, but they knew nothing of the mechanism of ventilation, or of the nature and properties of the deadly gases resulting from the combustion of coal in the locomotive. They could not even tell why air, when heated, flies upward. They were, however, very positive that they would make everything safe and secure, and assured me that they would not, after completing their arrangements, put the locomotive in the tunnel again until I had inspected the mine and pronounced everything safe. I measured the air floating through the mine, after the air-shaft was commenced, and finding less than eight thousand cubic feet in circulation to a working force exceeding one hundred and forty men and boys, and bad air prevailing in many of the working-places in the Hughes and Evans entries, complaint was made against the mine in regard to ventilation, the question of applying the locomotive not coming under the provisions of the mining law. A hearing was had before Judge E. B. Taylor, in Youngstown, on September 12th. The following is the testimony:

TESTIMONY OF ANDREW ROY.

Andrew Roy being duly sworn, on the part of the State, testified as follows:

Q. State when you last inspected this mine in controversy?

A. To-day.

Q. When did you examine it last before to-day?

A. A week ago Monday or Tuesday last.

Q. When before that did you visit it?

A. Sometime in June last.

Q. Explain to the court the meaning of this diagram (showing diagram).

A. This is not a plan of the mine, but a rough sketch, showing the location shafts. The shaft near the entrance of the tunnel is now in course of sink be thirty-six feet deep, and is meant to ventilate the tunnel when th in the tunnel again. I have no map of the mine. I wrote the company, after the accident in the tunnel, to send me a map of the mine, with the tunnel in it, and the workings extended to date, but they have not sent it to me.

Q. Did you measure the amount of air in the mine to-day?

A. I did. I made several measurements. The first showed 7,466 cubic feet of air flowing through the mine; the second measurement (the fire in the furnace having been stirred up) showed 9,240 feet. The third and fourth measurements were the same as the second. The fifth showed 10,320 feet. This last is the utmost power of the furnace.

Q. Were these measurements made at the same place?

A. I moved the instruments forward a few feet.

Q. Where were you when these measurements were taken? (Showing diagram.)

A. The upcast shaft is not on there. This sketch was made to show the danger of working a locomotive in the tunnel, more than anything else.

Q. How near were you to the upcast shaft when you made the measurements?

A. About fifty feet. The whole column of air was there, and passed that point.

Q. How many men are employed in the mine?

A. I do not know, myself, but the bank boss told me 170. (Objected to.)

Q. What is the quantity of air to each person, according to your estimate?

A. I have not figured it out.

Q. Will you reduce the amount to figures, on the basis of 170 men working in the mine?

A. It is a fraction over forty-five feet per man, taking the first measurement, which is the ordinary current of the mine.

Q. How much would it be at the highest measurement?

A. It would be sixty feet, without the fraction.

Q. Where is the furnace placed?

A. At the bottom of the shaft, called the upcast shaft, formerly used as a pumping shaft.

Q. Did you observe whether the air was properly distributed through the mine?

A. It was not properly distributed. There were but 350 feet flowing through the Evans entry; all the rest was lost by leakage at the doors, or stoppings on the way. Of the 7000 feet passing through the upcast shaft, only 350 feet found its way to the Evans entry, and this amount passed into the Hughes entry. There are at least thirty men at work in the Hughes entry.

Q. What special causes exist for rendering the air of this mine impure?

A. The causes are common to all mines. They are the lights of the mine, the smoke from powder in blasting, the breathing of men and animals, the exhalations from their bodies, the decomposition of shale, etc., and the distillation of black-damp from the coal and its associate strata, etc.

Q. By what means is the coal hauled out the mine?

A. It is now taken out by horses, through the tunnel.

Cross-examined.—Q. When was your attention called to that mine, before you visited it last?

A. A week ago Monday or Tuesday last.

Q. Did you go through the bank at that time?

A. I went through a part of it.

Q. Did you go through it where you made the air tests to-day?

A. I did.

Q. Did you ever say it was the best ventilated bank in Ohio?

A. No, sir.

Q. Did you not say that it was the best ventilated bank in Ohio, to Frank Buhl?

A. No, sir; nor to anybody else.

Q. Where did your observations extend, the last time you were in the bank?

A. At the upcast shaft, about one and a fourth miles from the mouth of the tunnel, and in the Hughes and Evans entries.

Q. In going to the upcast shaft, from the tunnel, which way did you turn?

A. I turned to the right, then to the left, then to the right, then to the left. The course of the entry is very sinuous.

Q. Who did you go with?

A. With the drivers. I went in about 8 o'clock in the morning, and took the measurements of air about 11 o'clock.

Q. What difference in time was there between the first and last measurement?

A. About eight minutes.

Q. How near to the furnace were you?

A. About twenty-five feet.

Q. Did you visit any other upcast air-shaft of the mine, to-day?

A. There is no other upcast shaft to the mine.

Q. How do you know there is no other upcast shaft?

A. The ventilating arrangements make it impossible. All the air must pass through the furnace shaft.

Q. Is the tunnel an upcast, or a down-cast?

A. There is no motion of air in the tunnel. There is a door in the tunnel.

Q. Where is the door located?

A. About 150 yards from the interior end—that is, from where the tunnel strikes through in the coal.

Q. If this door were kept open, which way would the air move?

A. That would depend upon the temperature outside. To-day, it would move outward and be an upcast, as the air is lighter outside than the mine air. In the winter, it would be an intake, the mine air being then lightest.

Q. Are there any doors between the intakes and upcast shaft?

A. There are a number of doors between the intakes and upcast.

Q. Do you know that some of these doors split the air, and send part of it through the mine in another direction?

A. That makes no difference; all the air must come back and pass through the upcast.

Q. Suppose that the air is split at these doors, and there is another upcast shaft, and part of the air goes up that shaft, that you did not visit, then you did not take the air going through that shaft?

A. I have already told you there is no such shaft.

Q. Suppose that there are doors between the entries and the bottom of the upcast, and that some of the air was split and drawn in another direction, then you did not measure it all?

A. Yes, I did. It must all pass through the upcast.

Q. You answered my question as to whether the tunnel would be an
cast if the doors were kept open, by saying it would be an upcast.

A. When I answered that question I was thinking of v
forces. Where furnace ventilation is applied, all the —

shaft, no matter if there were five thousand other shafts. The air is lighter in that shaft than in the others.

Q. Suppose the air in the mine was hotter than the air outside?

A. It would make no difference.

Q. If one hundred men were employed at work in the mine, with a ventilation of 16,320 feet of air per minute, would there be good air in the mine?

A. If they were employed where the air was bad, as in the Hughes and Evans entry, where but three hundred cubic feet of air was moving, there would not be good air there.

Q. Where was it you measured fifteen thousand feet of air to-day?

A. At the door of the entry near the furnace. When this door is opened the current of air, instead of passing around the air-courses of the mine, passes directly from the down-cast to the upcast along the main entry. The air of a mine increases or decreases in quantity according as the frictional resistance it encounters in passing along the air-ways is increased or decreased. This increase or decrease is as the square-root of the extent of the frictional resistance encountered. That measurement was, therefore, no test of the amount of air in circulation in the mine.

Q. Did you go through the bank and trace all the currents that go through the mine?

A. No, sir. I only went through the Hughes and Evans entries. The air may have been good in other parts of the mine for anything I know.

Q. I understood you to say there was no upcast from the tunnel, but you predicated that statement on the fact that the doors were kept shut. When the coal is being brought through the doors in the tunnel, that would make the tunnel an upcast, would it not?

A. No, sir, it would be an intake.

Q. Then you did not measure that air?

A. Yes, sir; it must pass out at the upcast shaft.

Re-direct examined. Q. Does it make any difference whether there is one shaft or fifty?

A. No, sir. The furnace shaft only will be an upcast; all the air received at other shafts will be discharged there.

By the Court. Q. How is the main entry of the mine reached—by a shaft or slope?

A. By a tunnel now; it is horizontal, or raises two feet to the hundred.

Q. While you were in the mine to-day, did you note the temperature of the air?

A. The temperature of the air of mines is uniform at 50 feet below the surface, and is 50 degrees. For every 60 feet of descent there is a degree of heat added. In the mine to-day the temperature would range from 50 to 52 degrees.

Q. Would that have anything to do with causing the air to flow to another air-shaft?

A. No, sir, it would not. All the openings except the furnace shaft are down-casts. The scientific reason is that the air in passing over the furnace becomes specifically lighter than the cooler air in the other shafts. The air presses in all the shafts alike, at the rate of about 14 7-10 pounds to the square inch, or a ton to the square foot, but air expands 1-459 part of its volume for every degree of heat applied. If the air in the furnace shaft were 250 degrees at the bottom and 150 at the top, and the air in the other shafts were 80 at the top and 60 at the bottom, there would be an average temperature of 200 degrees in the upcast, against 70 degrees in the down-cast; this would make a column of air one foot square and 100 feet high (the air-shaft being about 100 feet deep), at a temperature of 200 degrees, weigh, say six pounds, and an equal column at a temperature of 70 degrees weigh about eight pounds. The difference of pressure of two pounds forces the heavier column downward and the lighter column upward. This may not be the exact weight of air in the shafts, but I can work it out with figures in a few minutes, if you wish. If I balance my pencil on my finger in this manner (holding pencil on finger), and add two pounds weight to this end of it, the heavier end will go down and the lighter will go up.

Re-cross-examined. Q. Suppose you have a furnace at this air-shaft (showing map), and another furnace at this shaft, would not the air split in the mine, and part pass to this upcast and part to this one?

A. Yes, sir.

By the Court. Q. You say there is only 300 feet of air in the Evans entry?

A. Yes, sir.

Q. How many men are working there?

A. There are seven there. The air of the Evans entry also ventilates the Hughes entry, and there was so little air in the air-course of that entry that it would not move the anemometer.

TESTIMONY OF JOHN BEDDOE.

John Beddoe, being first sworn, on the part of the State, testified as follows:

Q. Where do you live?

A. I live in Brookfield.

Q. How long have you worked there?

A. About nine years.

Q. Did you work there to-day, and where?

A. I did, at the bottom of the upcast.

Q. What do you do?

A. I am tending the flue now.

Q. Is there any other upcast except the one you work at?

A. No, sir.

Q. Were you there when measurements were made by Mr. Roy, to-day?

A. I was; I saw them made—a part of them.

Q. Have you been through the bank within a few days?

A. No; I don't go through the rooms at all.

Q. How far is the Evans entry from the up-cast?

A. About a mile from there.

Q. How many men are in the bank?

A. I do not know.

TESTIMONY OF JAMES EVANS.

James Evans being sworn, on part of the State, testified as follows:

Q. Where do you live?

A. I live in Brookfield.

Q. What do you do?

A. I am a miner in the Evans entry.

Q. Were you working to-day?

A. I was.

Q. Was the air good or bad in the mine to-day?

A. It was bad; some days it is better than others.

Q. Was you in any other entry to-day?

A. No, sir.

Q. How many men are there working in the bank?

A. I don't know.

Cross-examined. Q. You work in a room?

A. Yes, sir; very near the top.

Q. Did Mr. Roy come in there to-day?

A. Yes, sir.

Q. Did Mr. Roy make any measurements there to-day?

A. No, sir.

Q. Did you dig coal all day to-day?

A. No, sir; I quit about noon.

Q. When did Mr. Roy leave?

A. He left before noon.

Q. Did he tell you the air was bad?

A. No, sir; I know that myself.

Q. You say the air is better some days than others?

A. Yes, sir; it was better to-day.

Q. How was it yesterday?

A. I was not in yesterday.

Q. How are the doors kept—open or shut?

A. The inside doors are always kept shut.

Q. There is some way to get air into the inside?

A. It goes through the wind-way; it goes in at the opening.

Q. How long have you worked in that room?

A. About a year.

Q. Did you use a light in there to work?

A. Yes, we did. It goes out sometimes; and when the lamp goes out we have to light it again before we go to work.

Q. Do you leave the room when the lamp goes out?

A. No, sir; I light the lamp again.

By the Court. Q. What other way can you tell the air is bad?

A. By the lamp, and the air coming in at the doors.

Re-direct examined. Q. Do you feel any different one day from another?

A. Yes, sir; we feel the best when the air is good. We get the headache in bad air.

Re-cross-examined. Q. Do you know what gave you the headache—whether it was bad air or eating kraut?

A. I do not eat any thing of that kind.

TESTIMONY OF JONATHAN HEAD.

Jonathan Head being sworn, on part of State, testified as follows:

Q. What is your business?

A. I run the coal banks for Mr. Andrews.

Q. Have you supervision of the Brookfield bank?

A. Yes, sir; for about two months.

Q. How many men work in this bank?

A. About one hundred and sixty-six are employed, but not working all the time.

Q. Do you include all the men?

A. Yes, sir; diggers and drivers.

Cross-examined. Q. About what is the average number of men, at one time, at work there?

A. About one hundred and forty or one hundred and forty-five.

Q. Have you been there, so as to know that?

A. No, sir.

Q. Who keeps account of the number of men?

A. Mr. McIntosh. I am not there every day.

ANDREW ROY RECALLED.

Q. With the measurements you made with the anemometer, and the number of men usually employed there, what would be the number of feet of air per man?

A. The ordinary current would show fifty-three feet per minute; the best the mine could do, seventy-one feet. I made these estimates from the smallest and the largest measurements. The smallest measurement is the ordinary current of the mine.

TESTIMONY OF JOHN M'INTOSH.

John McIntosh being sworn, on part of defense, testified as follows:

Q. You are the boss?

A. I am. I have been there since a short time after the accident occurred.

Q. What is the actual number of men working every day?

A. About one hundred and ten.

Cross-examined. Q. What means have you of keeping the number of men?

A. I am always going about and seeing the men.

Q. Do you have access to the pay-rolls of the bank?

A. I have. There are about one hundred and sixty-six men employed. I have always guessed that that number of men is at work.

Q. How could you get at the number?

A. I guessed. That is an estimate I have made.

By the Court. Q. How many were at work to-day?

A. I expect about one hundred and ten.

Q. What are the others doing when not at work?

A. A good many are farming, making gardens, etc. That number includes drivers.

Re-cross-examined. Q. When was your attention called to this—when did you ever think about the number of men that go in there?

A. I do not know the first time; I did so to-day.

TESTIMONY OF ISAAC HALFORD.

Isaac Halford, being sworn on part of defense, testified as follows:

Q. Have you had experience in bossing coal banks?

A. I have. I went in this bank Saturday after the accident occurred, and went through the bank nearly all one day. I went in down the slope, and out through the tunnel. I went in the bank again last Monday, and wherever there was a door that went across the way I opened it, and followed up to the end, and I have been traveling for most three days through the mine to find if there was anything wrong in the air. Put the lamp on the table here and it burns freely, and you get good air, although there is no current. In this weather the air is not as good as it is in good weather. I say this on oath, and I have found no signs of gas that explodes, or fire-damp—not any appearance of black-damp. That puts out the light. You can work in black-damp, if it is not to strong. The white-damp is different; it takes an expert to tell that; and one wr that it affects the head until you drop down. It is removed by air. I did not see any evidence of it in the mines. I say to your Honor, considering myself strictly under oath, least that I have worked in the coal mines for nearly half a century—forty-seven years at—and I do say that I never in my life went through a coal mine that was so largely mined out as this in question, that was better ventilated than this one. This gentleman has a new theory—a little windmill to test the air. Here I do say, that in damp weather the air is not so good as it is in clear weather. To-day, when he was testing the machine, I held a light to see the instrument, the air was so strong that it would blow the light out.

Q. Taking into consideration the number of men working there, what is the air, good or bad?

A. I should say there was plenty of air there. I never had a man under me in my life that was injured by bad air.

Q. Did you observe the number of openings in the bank?

A. No, sir. In a month from this time, that bank will be as good as a bank can be made.

Q. Did you notice whether there was another upcast?

A. Mr. Roy did not get all the air. The door where he figured on he would have supposed that he got it all. If he had looked around, he would have found where there had been a small boiler, and there is another upcast from that.

By the Court. Q. How many cubic feet of air was passing per minute?

A. I do not have any idea how many feet was passing. I went into the air entry to-day, in the forenoon, before Mr. Roy was in there. There was no current, but the air was good. I went into the Hughes entry about eight or nine o'clock. They are stopped in the Hughes entry. They are not working, for they are ahead of the air.

Direct examination. Q. Have you been in the tunnel?

A. I have been in the tunnel, and saw how the doors were arranged.

Q. How would it be as to that operating as an upcast of air?

A. When the train stands still there is no current on the lamp, but as soon as it stirs, it is so strong as to nearly blow out the light. When the train is going in, the air is going out. We have to change the air in the winter; we must run it before us.

Cross-examined. Q. You say that when the cars are not in motion the air is still?

A. Yes, sir.

Q. Is that because the door is there?

A. I said to one of the mem going in, "Smoke your pipe now, and see how fast the air is going."

Q. If the air is still, it shows there is no current there?

A. Yes, sir; because when the doors are shut it cannot move. I do not know anything about the current or volume.

Q. How much time have you spent there in the last few days?

A. I went in there last Monday, at the request of Mr. Andrews, to examine the air in reference to testifying here.

Q. How did you test the air?

A. I had no machine, but I thought the air was pretty good when it blowed the machine.

Q. What do you say about the movement?

A. It was moving; I observed it by lamp-light. I do not know whether I was in the Evans entry. I think the Hughes entry was not working to-day, but they were in the rooms.

Q. Were you in Evans's room yesterday?

A. I do not know. There are two places for the air to get in at.

Q. Where is the furnace placed that gets up the draft?

A. About twenty-five feet from the shaft. The furnace is nearly at the bottom of the shaft.

Q. Would not the air go through the furnace if it were heated?

A. The air will go up the nearest place it can go. The other place for it to go out can not be more than forty yards away. I say that the air would not all go through the furnace, but some of it would go up the other upcast. That boiler splits it, and part goes up the furnace and part goes up it. I saw no appearance of bad air in all my examination in the Brookfield Mine. The weather had been very unfavorable during our examination. In coal mines, as a general thing, the air is not so good as it is in clear weather.

Q. What is the reason of that?

A. I do not know. Mr. Roy can explain that.

Q. Would the wind blowing help the ventilation?

A. It depends upon which way the wind blows.

TESTIMONY OF JONATHAN HEAD.

Jonathan Head, being sworn, on part of defense, testified as follows:

Q. Explain to the Court how many openings there are in that mine, and the whole length of them (showing map)—how many places where men can get out.

A. There are two places.

Q. How many air-shafts are there besides the tunnel and the slope?

A. There are two that I know of. There are three perpendicular shafts, the opening and the tunnel; one of them is an upcast shaft.

Q. Were you present with Halford to-day?

A. I was. We were in Hughes' entry to-day about 10 o'clock; we were not in Evans entry; I have been in before to-day, but not with Halford. No work has been done in the Hughes entry for some time, for the coal is sulphury; they were working in the rooms in the Evans entry.

Q. How long have you been in the mine business?

A. About fourteen years; I have the general superintendence of all of Andrews' mines.

Q. What condition did you find the air to-day?

A. Mr. Roy measured in the Rees-Samuel entry; that is turned off the Hughes entry; there are men working about thirty yards from there, or nearer the tunnel.

Q. What was the condition of the air in that entry?

A. The air was good; I had no way of testing it but by the lamp burning.

Q. Was you present when Mr. Roy made his measurements at the bottom of the upcast shaft?

A. I was.

Q. Would that measure all the air?

A. No, sir; Mr. Roy, in the first place, measured the air on the Scotch entry, and he
had some over 7,000 feet; when he tried it, the man that was tending the furnace
damp fire, and also shut the doors; he tried it then; the fire was damped dow
ways keep a strong fire there; I asked him if he would try it again, and
opened the furnace doors, and stirred up the fire; I went back, and
I told him to try it in another place; I then went back and opene

running side of the boiler, and then he got some 9,000 feet; after he had got that I asked him to try it again; I went back and opened a door right at the bottom of the upcast, and we tried it there, and then it was over 10,000 feet; after that was done, Mr. Roy turned to me and said, "I want to see what you have done," and when I told him he said that would make some difference, and when we went to measure it back of the furnace, he said, "I am afraid we can not get it—there is too much smoke and steam; but if I had a thermometer here, and tried the temperature at the top and at the centre, I could tell the exact amount of air that would go up that shaft;" we opened up another door, and he put the instrument there; the lights went out two or three times, but I finally kept one lit; he then tried the air again, and I held the light so that he could see it, and the instrument went around six times, calling the size of the door five feet two inches, by four feet ten inches, and he called it 15,000 feet; after he had got it from the shaft, I asked him if it would make any difference if there were any other shaft and air-current, and he said no, there is no place where he did not measure it. Where he tried it there is solid coal; there are rooms in the Scotch entry where the air leaks through and goes into a place where the boiler was; it was put in there for running the pumps; there is a place where this does not go near the fire, but rushes near the bottom and goes up; that is part of the air that circulates in the bank; the air passes in front of the grate bars; the whole area is not taken up by the furnace; the door that he had 15,000 feet at is the door that is kept shut for the air to circulate around; when that is open he will get the full volume of air, except what goes up the other shaft.

Q. Did Mr. Roy get the whole volume of air in the mine?

A. No, he did not, because there was an air-shaft in Crew's entry, and that air was separated entirely from the place where Mr. Roy had measured it.

Q. How often are the doors open for the purpose of taking out coal?

A. That door in the tunnel is open when the driver goes through, and when the men are going out of the tunnel, and the men are coming in; I do not know how often they are open; a boy is kept there constantly to attend the doors.

Q. When the doors are open, how does that operate?

A. I do not think it operated as an upcast in the tunnel; as a general thing, the air would go towards the air-shaft.

Q. Did you tell Mr. Roy that?

A. No, I did not; it was none of my business, and I did not propose to tell Mr. Roy all that I knew.

After the hearing of the above testimony, which occupied the whole evening of September 12, the suit, at my instance, was held in abeyance to give the owners of the mine time to improve the ventilation, and erect a furnace or fan of such proportions and power as would make the tunnel safe when the locomotive was taken in again.

It will be observed, from the testimony in the trial, that practical miners, as well as doctors, will disagree, Messrs. Head and Halford both swearing that I did not measure the whole volume of air in circulation in the mine. Neither of these men knew anything of the natural laws and principles which govern the motion of air in mines. When I measured the current flowing into the upcast shaft, after it passed round the mine, and found 7,000 to 9,000 feet as the ordinary current of the mine, and then opened the trap-door near the furnace and allowed the air to pass directly from the upcast to the down-cast, thereby shortening the distance two thirds or three-fourths, the air increased in volume to 15,000 feet. These facts astonished Messrs. Head and Halford, and they concluded that as I had found 15,000 feet at one place, and only 9,000 feet at another, I could not have got the whole current where the 9,000 feet were measured. The two "upcasts" which they so persistently held to were simply two entrances to one upcast. I measured the current outside of both places, and so got the whole column, and this they saw me do.

The reason why the current of air increased from nine thousand to fifteen thousand feet per minute by the opening of a single door was owing to the shorter route the air traveled; the current, instead of passing around the mine, moved straight from one shaft to another. If the down-cast and upcast shafts had been within two hundred yards of each other, instead of about half a mile, the same ventilating pressure would have moved thirty thousand feet of air instead of fifteen thousand, the volume of air increasing as the air-ways are shortened in proportion to the square root of the extent of the rubbing surface. The judge on the bench, who had probably never been two hours in a coal mine in his life, understood that air is retarded by the frictional resistance it encountered in passing through the air-ways of mines, or through air-ways of any other substance; but Messrs. Head and Halford, who had been practical miners from boyhood, and had had charge of the ventilation of mines for many years, seemed never to have heard of such a thing.

The Mahoning Coal Company's Mine, No. 3, is a very extensive mine, and usually works an underground force of two hundred men and boys, of whom one hundred and fifty are employed in digging and loading coal, twelve in driving mules, twenty-five day-men laying track, blasting roof and bottom, etc., and the balance of the force is distributed at other work, such as trapping, etc.

When this mine was opened, it did not promise well, the coal being thin and having a white roof, and the swamp was narrow. All the work east and north of the bottom of the slope was in this low coal. These workings have been finished up long ago. On the west side of the slope, however, the thin coal and white roof were replaced by the whole height of seam and the ordinary grey shale cover, and the swamp broadened out into a valuable and extended basin. The line of direction of the mai
swamp is a little south of east. Six hundred yards from the bott
the slope, a ridge occurs in the swamp, the strata gradually risin
directions for two hundred or three hundred feet. They im

over again, on reaching the arch, into the regular swamp level, when the trough-like shape is resumed, and the swamp extends forward.

Two accidents occurred in this mine from explosions of fire-damp, by which two Italian miners were severely burned. On the occurrence of the second accident, I visited the mine the second time to see the manager in regard to the explosion, and the best means to prevent a recurrence of the same. The manager was not at the mine, and I left a letter calling his attention to the matter. The following is his reply, which is corroborated by many of the miners:

COALBURGH, OHIO, *June* 21, 1877.

MR. ANDREW ROY:

Dear Sir—In answer to your favor of the 18th inst., I beg to say that I had posted on the top of Slope No. 3 that no man would be allowed to go into James Coles' entry until the fireviewer had examined the places suspected to generate fire-damp, under the penalty of instant dismissal from the Company's employ. The two Italians burned had no business in that part of the mine, as they do not work on that entry, and are suspected of wandering up and down the bank, pilfering, as I have many complaints from the men losing oil, etc. These men had gone very early to work, and were burned and home long before the other miners started out to work, and were themselves to blame. You may depend that I use my utmost endeavors to prevent accidents.

I am, sir, yours respectfully,

CHARLES HERBERT.

I visited this mine again in September, after the completion of a new slope opened at the interior of the workings. This is also a hauling slope, and was sunk to cut off the hauling roads under ground, over the arch of the strata alluded to as crossing the coal basin. At the bottom of this new slope, the air is sent forward on the main entry, and made to ventilate a range of work on the left side of the entry, thence it returns to the bottom of the slope, and passes across the main entry by an overthrow or overcast, and distributed through the workings on the right side of the mine. A column of air received at the mouth of the old slope ventilates that part of the workings outside of the anticlinal which crosses the swamp; this current, after ventilating one side of the mine, being sent across to the other side by another overthrow in the entry.

The Stewart Bank, operated by the Mahoning Coal Company, is situate in the north-western part of Hubbard township. The mine is a slope opening, dipping one foot in three. The bottom of the slope struck the coal on a hill-side fifteen to twenty feet above the "swamp," and the slope was continued downward through the underlying Waverly sandstone to the level of the coal in the swamp; then a water-level tunnel was carried forward to the swamp through the "bottom rock." The strata underlying the coal, composed of thin alternating layers of fine-grained blue sandstone and light gray shale, occupy horizontal sheets, while the coal seam above dips at the rate of twenty degrees, and this is one of the numerous proofs, to which attention has been called in previous reports of the coal swamps, of the Mahoning Valley being scooped out of an originally level plain anterior to the deposition of the coal vegetation.

The coal in the Stewart Mine is of unusual thickness, sometimes rising to seven, and even eight feet, but much of the bed is composed of "cannel coal," too earthy in character for commercial purposes, and is left unwrought in the mine.

The cannel coal appears near the middle of the seam and is of varying thickness, rising from an inch to three and four feet, and it is so distributed in the basin as to throw doubt on the theory that it was formed in lagoons of open water. In the swamp it may be present in two or more feet of thickness, and in going up one hill-side this thickness may increase while the whole seam is losing height, and on the other side of the swamp, on the hill-side occupying the same horizon, the cannel may have gradually thinned out and disappeared altogether.

The main swamp entry of this mine branches off in opposite directions at the bottom of the slope, the eastern entry wheeling back and passing under the slope. Branch swamps, in which entries are driven, extend both north and south, but they run up on hills or into thin coal, and are soon lost. On the west side of the workings the swamp splits in two—one branch extending to the south and west, and the other to the northwest. In both of these branches the entries had to pass through an extensive deposit of cannel coal too worthless to be mined and raised to the surface.

Both the Stewart and No. 3 Mines were in good order in their ventilating arrangements. Air-courses are driven alongside of the entries, and are kept well forward, while the circulating current of air is well distributed In No. 3, in the butt entries, the rooms are started off the air-course on that side of the entry, a switch leading into the air-course at every fifth room. One trap door is thus made to serve the purpose of five doors. and as a result there is little leakage of air through open doors. The ventilation of both the Stewart and No. 3 Mines of the Mahoning Coal Company was very much better than it was in former years, and none were more ready to acknowledge this change for the better than the miners themselves. In No. 3 Mine the boilers for supplying steam to the steam-pump are placed at the bottom of the upcast shaft. The heat from these boilers and the exhaust steam from the pump, combine to rarify the air in the upcast shaft. The air, by being split in two in No. 3 by the new slope, shortens the route the curre have to travel in that mine, and this also adds to the amount of wind moving through the workings.

The Burnett Bank and the Hall Bank are operated by one company; the Hall opening is an extension of the Burnett Mine, and was sunk at the head of the Burnett workings in 1870 to lessen the cost of underground haulage. Nearly all the work in the Burnett Mine, which is the older opening, is pillar work, the rooms having been finished up. Both openings are slopes. The Hall Mine is the most northerly of the two. The Race-course swamp of this mine connects on the south side with the main swamp of the Burnett. On the northern side of the Hall Mine, where the miners are engaged, there are five entries, as follows: The Baltimore entry, the Ashtabula entry, the Main entry, the Mecklenburg entry, and the Eureka entry. The Ashtabula and Baltimore entries run in swamps on the butts of the coal, the swamps finally rising and running out on hills like the end of a canoe; the main entry and the Mecklenburg entry go through in the Love bank, opened to the north of the Hall; and the Eureka entry goes through into the exhausted workings of the Eureka Mine.

In the Baltimore and Ashtabula entries the miners were engaged on the pillars, and in many places the superincumbent strata had fallen, liberating carbonic acid gas. As the ventilating current of air had to pass along the Baltimore entry, thence to the Ashtabula entry, thence to the more northern and western portions of the mine, the current was heavy with black damp before it reached the miners.

I visited this mine, having received a letter from one of the miners complaining of the defective ventilation prevailing, and requesting me to make a personal inspection of the mine. I made a number of suggestions in regard to improving the air, which if carried out will not fail to produce better results. Owing, however, to the extraction of the pillar coal along those divisions of the mine where the air must pass ere it reaches the miners, there will continue to be an impure atmosphere in a greater or lesser degree, and the proper remedy would be to change the course of the air current, causing it to return to the upcast by way of the goaves of the mine.

The Love Bank is situate a mile north-west of the Burnett bank, and is opened on the same basin of coal, the main entry of the Hall Mine, as stated in the notes of that mine, going through on the swamp entry of the Love Mine. This mine was opened in 1871, and will be finished in the course of twelve or eighteen months, nearly all the miners being employed on the pillars. The coal laid in a broad swamp, but when the entries took the hills they rose rapidly, and the coal thinned out. There were five entries in the mine—the old Main entry, the Black entry, the Miller entry, the Little entry, and the new Main entry. The entries were driven three yards wide, the rooms started off at three yards, then widened out to eight yards, leaving four-yard pillars. The ventilating current was due to a furnace located at the foot of a shaft sunk on the side of the slope, about half way from the bottom. The current was too feeble for an extensive mine, but it was well distributed. The miners working on the return, who got the last of the air, found it thick and heavy.

The Applegate Mine has not been running very regularly during the past three years, but it is now working every day with a full force of miners. The workings were inspected during the month of August, complaint having been made to me that part of the mine was approaching the abandoned workings of an adjoining mine, believed to be filled with water and noxious gas. The workings of this old mine had been wrought over and abandoned before the mining law went into operation, and I had no map of them. There was an air-shaft still standing firm, and on letting down a stone fastened to a cord, I discovered there was no water in the bottom of the pit. I then let down a lighted lamp on the cord, but the light went out before the lamp reached within sixteen feet of the bottom. As the gas was non-explosive, and could not, if tapped from the Applegate mine, travel any faster than the air in this part of the work, I concluded that there was no danger of losing any of the miners from holing into these old workings, and so notified the mine superintendent. About four weeks after my visit the old works were reached without danger, and a cause of constant uneasiness and dread on the part of the miners was removed.

The ventilation of the Applegate Mine was not as good as it ought to have been. On measuring the air flowing through the mine, found the current too weak, and bad air prevailing in a number of working places, particularly those places which got the last of the air on its return through the mine. One of the mine owners had been through the workings a few days before my visit, and had noted the unsalubrious condition of the air. On my recommendation the mine superintendent purchased one of the Champion Mine Ventilating Fans, to erect it at the top of the air-shaft. Should this fan be in operation before this report is published, I will speak of its size and power in another place.

The Cleveland Shaft is another mine which has not run well during the past two or three years. This mine was also visited in August, but it was not working at the date of visit. I, however, went into the pit, passing down by the slope or traveling-way. I found this traveling-way to be a very badly constructed slope, steep in its ascent, and unsafe for the ingress or egress of miners carrying picks. A person could not come up or go down without clinging to a wire rope fastened in the passage way. The mine boss informed me he had urged the company to fix the traveling-way so that mules could pass up and down. The top of the shaft of this mine had no entry gates.

The Truesdale Mine of the Hamilton Coal Company is situate one mile north-east of the center of Vienna township, in Trumbull county. The shaft is eighty-two and a half feet deep, and was sunk in January, 1876. There is but one opening though, as less than 15,000 square yards are excavated; the time required by law for providing the second outlet is not yet due. Ventilation is provided by means of exhaust steam from the pump at the bottom of the pit. The main entry at the date of inspection had just got through a horse-back, and the air was poor in consequence, but air-courses were being made.

Where this shaft goes down, the material covering the coal is sandstone, containing the pebbles of the Conglomerate. In the swamp entry this roof is supplanted by the ordinary grey shale cover. Coal No. 2 is not present in the shaft.

There is no workable coal north of this opening, and the only coal discovered by the borers is a seventeen inch seam on the coal level, on the farm of Gad Andrews, one mile north-east of the shaft.

The workings of the Vienna Coal and Iron Company's Slope, No. 2, were finished up during the forepart of the present year, the last car being raised on the 19th of February. No. 1 was inspected in May last; it was also fast approaching exhaustion; only one entry was running, all the others being worked out, and the greater part of the pillars withdrawn. This mine was also finished during the summer. Both mines, No. 1 and No. 2 of this company, are now abandoned.

The basins or swamps in which these mine were opened, lie on the margin or out-crop of the coal-field, and much of the coal appears to have been partly or wholly removed by denuding forces, by currents of water in rapid motion, or by shore waves, probably the latter—during the first stages of the subsidence of the coal marsh. Five mines, the Truesdale; the Tyler; No. 1, No. 2, and No. 3 of the Vienna Coal and Iron Company, were opened on one original basin or swamp, and yet none of these mines connect with each other. The swamp or basin connects beyond a question of doubt; but the coal between the several mines, invariably meets with a white roof in the swamp; as the entries are pushed under this roof, the coal gradually but surely loses hight. The thin coal will not pay the cost of extraction, and is left unwrought in the mine.

The new shaft of the Vienna Coal and Iron Company, No. 3, was commenced on the 19th of January last, and was sunk to the coal in twenty-four and a half days—the depth being eighty-seven and a half feet, the size of shaft eight by sixteen feet. The hoisting engine of this pit is Crane Brother's patent, the engine instead of being located to face the front of the shaft, as in ordinary winding practice, is placed at the end. The shaft is divided into upcast and down-cast compartments by a wooden brattice, and a steam pump at the bottom of the upcast serves to rarefy the air.

This mine was visited twice during the year, once in May after coal was reached, and once in September, after the entries had got well under way, and a good force of men at work underground. The main swamp in which the face entries are opened, appears to split into two branches in the south, and two swamp entries are advancing on this side of the pit, and one on the north side. The main entries are already advanced several hundred feet, and from off them several butt entries are opened up. The face and butt entries are made eight feet wide. Along the swamp entries small air-courses were being driven but too near for the easy flow of air. The rooms of the mine are started at eleven feet, then widened to twenty-five and thirty feet, pillars six to eight feet in thickness being left between rooms. On the occasion of the last visit the cages of the shaft were covered, safety catches and safety gates were applied, but the mine had but means of ingress and egress, and the ventilation was miserable. As less than 15,000 square yards had then been excavated, the mine was working within the limits of the law in this regard, but not so as regards ventilation, and being a new mine there was no excuse for bad air.

In one of the hills in a butt entry, a second opening, consisting of a slope, was commenced a few days after my last visit, the steam pump was also lowered to the bottom of the shaft to assist the ventilation, and the leaking places in the brattice stopped up. But the ventilating power is still deficient, and a furnace or fan is needed and must be applied. A new mine should have a ventilating fan, with ample power to increase the current many times beyond the requirements of laws, so that when the workings extend, and the frictional resistance increases, there may still be ample power to the end.

The Sodom Slope, owned by the McCurdy Coal Company, and operated by John Stambaugh, is the most northerly of the series of mines in Liberty township. The bottom of the slope enters the main swamp; two main entries, one extending westward, called No. 2, and one extending eastward, called California, branch off at the slope bottom. The basin is narrow and sinuous. The eastern swamp wheels to the south, then to the south-east, until it nearly follows the western extension on a parallel line, a high hill of the Waverly strata cutting out the coal between the entries.

The ventilating current was abundant for the requirements of the mine, but the air was not well distributed, and in entry No. 2 a number of the miners were in a dull and heavy atmosphere unfit for the abode of man. The air-course was far behind the entry face, and reliance for air was had in cutting through from one room to the other. In the Centennial and California entries the ventilation was better, but the air-courses were also too far behind. The superintendent promised me that he would drive air-courses and keep them abreast of the entries.

The Hood Mine has been improved in its ventilation by the driving of air-ways, overhauling and closing stoppings, and it was in good order underground when last inspected, but having no means of ingress and egress available for the miners, complaint was made against it in common with all others in the Mahoning Valley. This mine is situated between the Sodom Slope and the Church Hill Slope, in both of which latter the coal in the swamps is never less than four feet, while in the Hood bank, in the swamps, the bed is much thinner, and the swamp is also much narrower. Mine owners can not be blamed for endeavoring to work with as little expense as possible who are operating banks that do not pay well, and a condition might arise under which some of the provisions of the mining law might be suspended in order to make the extraction of the coal possible. If such a condition should arise, the courts, and not the mine inspector, should have the power, after hearing the case, to say whether or not the circumstances justified suspension of any provision of the law; but under all conditions the safety of the miners should be assured. To this all other considerations should yield.

The Church Hill Slope is the largest and most extensive mine in the Mahoning Valley, unless, possibly, the Brookfield Slope. The workings extend to those of the Church Hill Shaft on the south-east, and to those of the Kline Slope on the south-west, the main openings of these three mines being each fully one and a half miles apart. The Centennial Shaft also, sunk half a mile north of the slope mouth, passes into the workings of the slope. There is a furnace and air-shaft for ventilation. The air, which formerly came down the slope, now enters the mine by the Centennial Shaft. The furnace is not maintained as it ought to be for so extensive a mine. The furnace man has to dig the coal for the fire and keep up the furnace, and as he is an aged man, has more work than he can do. The air-courses of this mine, also, are frequently too far behind, and the entries and interior rooms have often bad air in consequence. I have repeatedly notified the mine boss, and the mine owners, of the necessity of more attention being paid to the ventilation; and improvement has frequently been made, but not maintained—the mine being allowed to go back to its old order of neglect, to save expense.

The workings of this mine are so extensive, and the air has to travel so great a distance, that unless daily supervision of the ventilating arrangements is had, there can not be good air. All the butt entries ought to be made double, and the air doors erected at the point of rooms thrown aside. There is neither necessity for, nor economy, in the present plan. The air-courses should also be made at least thirty feet of sectional area. Air, as is well known to intelligent, practical miners, is greatly retarded in its passage through the mines by the friction it encounters in rubbing against the sides, top, and bottom of the air-ways. I have measured the column of air passing into this mine when the doors used for guiding and directing the current through the workings were open, and found 20,000 cubic feet of air per minute moving; and when these doors were shut the current became reduced to less than 10,000 cubic feet per minute.

The furnace of this mine is large and well constructed, and if a vigorous fire were maintained, and the air-courses widened out to thirty feet of sectional area, 30,000 cubic feet of air per minute could be made to sweep the mine. It would not cost a single cent of additional expense to keep such a current moving, but the sixty to eighty trap-doors would require to be thrown aside, and double entries driven in their stead.

The Centennial Shaft, as its name indicates, was sunk last year. It is a one-horse concern, and was sunk to get at some coal on the Taylor farm, adjoining the mining leases of the Church Hill Coal Company. There is but one cage in the shaft. As a loaded car comes up, a rope, with an empty car attached to the end of it, goes down, acting as a back balance, something after the manner of the old farmer, who, when going to mill on horseback, put the grain in one end of the sack and a stone in the other end. This shaft, when first sunk, had neither safety-catches, safety-gates, nor cover, but it is now provided with such fixtures as the law requires. A new rope has also recently been applied for hoisting.

The Church Hill Shaft was visited in January last. This mine, as noticed in previous reports, is ventilated with a fan, the first erected in the State. The fan was too small, and revolved too slowly for the work required, but its introduction was prompted by a desire to make the mine as safe as possible, and to improve the ventilation. At the time of inspection, all the entries of the mine had reached the boundary of the mining leases, or the coal had thinned out, and work was about being commenced on the pillars. The Church Hill Slope, and the Church Hill Shaft, as also the Halliday Slope, were complained against last year by reason of defective ventilation at the working faces of the mine. On the assurance that no further cause of complaint would be possible, the suits were discontinued, a special inspection of each of the three mines being made before the suits were withdrawn. There is more trouble in getting mine bosses to provide and maintain the necessary ventilation than with all the other requirements of the law combined.

Kline's Slope is three hundred and ninety feet in length, dipping one foot in three. It passes through three thin strata of coal before reaching the main seam. Near the bottom of the slope the air-shaft of the mine is located. The furnace is a double one, and when both flues are well fired up the ventilating current of air is amply sufficient for the requirements of the mine. There are four swamp entries in this mine, following two main swamps in opposite directions. The "Dip" and "Ireland" entries are in the one swamp, the "Dip" running in a general north-east course, and the "Ireland" in a general south-west course. The other two swamp entries are called "Carluke" and "Cornwall." "Carluke" branches off the main swamp on the "Dip" entry, and extends north-west for two hundred yards, then wheels to the west and south-west. Between "Carluke" and the bottom of the slope, "Cornwall" branches off on the other side, and runs southward. These two swamps cross each other; they are both quite narrow, the coal rising rapidly, and thinning out on the hill-sides. In working this mine, the entries are driven nine feet wide; the rooms opened at nine feet and widened to thirty feet, the thickness of pillar between rooms being nine feet. The ventilation is guided and directed by trap-doors, and the room-workings are generally provided with good air, but there is neglect in getting air up to the face of the entries. In the "Dip," at the date of inspection, the air was not good. Over a great part of this mine the shale roof covering is often not more than three feet thick, though the whole thickness of cover is one hundred and forty to one hundred and sixty feet. All the overlying material is composed of the "Drift"—clay and gravel—showing the site of an ancient creek or river. The eroded strata are scooped down to the swamp of the mine, and conform to the old trough, in which the coal reposes. The shale cover over the coal is about three feet thick in the swamp, and about the same thickness in the hill-sides, where the coal thins out. The "Dip" entry of this mine will connect with a swamp entry of the Church Hill Mine advancing from an opposite direction. There appears to be no fault in the way. The entry called "Ireland," extending south-west, would, were no horseback encountered, connect with the workings (long abandoned) of the old Briar Hill Mines, two miles distant.

The Powers Mine and the Reno Mine, situate one and one-half miles west of Youngstown, formerly operated by the Powers Coal Company and the Reno Coal Company, were during the present year operated by the Powers Coal Company. The Powers Mine is nearly wrought out, only fifteen men being at work drawing pillars in September.

The Reno Mine was working a force of forty men. The workings extend along a narrow swamp on both sides of the slope bottom. The air is split, near the slope bottom, into two columns, one split following the right swamp entry, and the other the left swamp entry. The air-shaft and furnace of this mine are too small to cause a brisk movement of air, though the working places were clean and sweet, except at the entry faces—the mine being comparatively new and the workings of limited area. The mine boss, who is a very intelligent man, informed me that another air-shaft would be sunk in the spring, and an ample furnace located at the bottom of it.

During an official visit to this mine, my attention was called to the boiler of the hoisting engine by a gentleman living in the vicinity, who informed me it was in a very unsafe condition, liable to burst at any time, and that the last time the boiler was cleaned and filled, the engineer, dreading an explosion, hid himself. As this slope had no available means of ingress and egress in the second opening, I placed the mine in the hands of an attorney to be complained against, both by reason of lack of available ingress and egress in the second opening, and the unsafe condition of the boiler. At the same time, I wrote the foreman of the mine as to the condition of the boiler, and received the following reply:

POWERS' COAL COMPANY, YOUNGSTOWN, OHIO, *September* 19, 1877.

MR. ANDREW ROY:

Dear Sir—I was favored with your note yesterday. In regard to the Reno Bank boiler, I will state that since I got charge of it, it has been repaired twice, once over the fire, and once on the back end of one of the flues. Last time it was repaired, the mechanic said to me he did not see much wrong with it then; and from the external and internal appearance, I do not apprehend any immediate danger. It is a double-flued boiler; its diameter is three feet; it is twenty feet long, with plates three-sixteenth of an inch thick, and working with forty pounds pressure. The safety-valve raises at forty-five pounds.

With respect,

ROBERT HUNTER.

The Haroff Slope is the most southerly of the series of mines on the line of the Niles and New Lisbon Railroad, opened on the block coal.

The slope is one hundred and forty-three yards in length, dipping one foot in three. There are two shafts beside the slope, one of which is used as an upcast, at the bottom of which the ventilation furnace is placed. The other shaft is used for pumping water.

The main entry, following the swamp, runs in a general north-western direction. The basin is narrow and steep, the coal pitching sometimes twenty-five to thirty degrees. The butt entries are laid out every one hundred and ten yards, and extend on both sides of the swamp. The rooms are thirty feet wide, are opened on each side of the butt entries, and meet in the middle of the block. The thickness of pillar between rooms is six to eight feet.

The slope-opening and the pumping-shaft are both down-casts, and each column of air ventilates separate divisions of the mine. Both streams, after passing the working places of the miners, unite in the main entry, thence flow to the furnace, and are passed through the upcast. The pumping-shaft, sunk in the spring of the year, materially assisted the ventilation of this mine.

The Pennel Slope is four hundred and eighty-five feet in length, and dips fourteen inches to the yard. The air shaft is one hundred and thirty-eight feet deep, and has a ventilating furnace at the bottom. The main entry extends south-west and north-east from the bottom of the slope. There is but one swamp in the mine, and the basin is less than one hundred yards in width. The coal, in ascending the hills, never thins out to a point, but is usually fully two feet in thickness, when a white roof of fire-clay or sand-stone is encountered, which suddenly cuts out the coal.

The rooms are twenty-seven feet wide; the pillars nine feet thick. The butt entries are one hundred yards apart; rooms working off both sides.

An air-course is driven along side of the main entry in both of these galleries, and the air is generally kept well up towards the entry faces.

The Haroff and the Pennel Mines have not run much in the past three years, and were inspected for the first time this year. In both mines the arrangements for ventilation are good, and if the furnace is maintained and the air-courses kept up, there can be no cause for complaint.

Coal No. 2 is forty-seven feet above Coal No. 1 in the pumping-shaft of the Haroff Mine. In the slope, the distance is about the same. In the air-shaft no other coals are shown, though in the slope two additional beds, both very thin, are met. In the Pennel Slope, situate half a mile north of Haroff, no coals were encountered in sinking, except the main seam at the bottom of the mine. In the Haroff Slope, Coal No. 2 is fourteen inches thick; in the pumping-shaft it is three feet two inches thick.

About one hundred and sixty feet above the horizon of Coal No. 1, the blue or lower limestone appears; it has been quarried on the surface for furnace use, in the neighborhood of the Pennel Slope, and is from one to two and a half feet in thickness. Coal No. 3, so often underlying this layer of limestone in other parts of the coal field, is wanting; immediately below the limestone, a stratum of iron ore is found, which is quarried and sent with the limestone to the furnaces of the valley.

The Foster Shaft is the deepest in the Mahoning Valley, being two hundred and forty feet in depth. There is a bed of limestone two and a half feet in thickness, thirty-two feet befow the top of the shaft. Immediately below the limestone, a massive sandstone, one hundred and eight feet in thickness, was passed through. The coal is five and six feet thick in its best developments, but where the shaft was sunk, the seam is troubled with horse-backs, which cut out the coal in the swamps of the mine. The first horse-back met was one hundred and fifty yards thick. The second fault is one hundred yards east of the first one, and the coal between the two faults is thinner than it should be. This second fault is about one hundred yards in thickness. The roof over the thin coal in the horse-back, as well as the material resting on the floor of the second, where there is no coal in the fault, is either sandstone or fire-clay, or a mingling of both.

The coal floor in the swamp of the mine is a stratum of fire-clay three feet thick. This rests in turn upon a bed of sandstone. The trough in which the coal reposes, where the shaft went down, is narrow and abrupt. One of the drill-holes, put down one hundred and fifty yards from where the coal is five feet thick, struck the "flag-rock"—the Waverly sandstone—fully one hundred and ten feet above the coal level in the swamp. In the vicinity of West Austintown, where the Haroff and Pennel Slopes are sunk, the "flag-rock" is sometimes met forty feet below the surface, while the coal itself in the swamps of the mines is one hundred and fifty feet of perpendicular depth. These basins are very narrow, and the coal rises at once out of the swamps, climbing up the hill-sides at the rate of twenty-five to thirty degrees.

Coal No. 2 is met in the Foster Shaft, but it is thin and worthless. There is no coal immediately below the limestone.

In the Pennel Slope, the main coal sometimes splits in two, but soon re-unites the intercalated material in hard, gray shale. This mine is situate two miles south of the Thornton Mine, where the seam is split up by the intercalated, wide-awake shale and the black-band ore. The gray, hard shale appearing in the coal at the Pennel Mine, is the faint appearance of that material, which splits the coal at Mineral Ridge, until the two benches are sometimes four and five feet apart.

The Foster Mine and the Osborne Mine were visited and inspected on the 6th of February. Both are shaft openings, and they had each but one means of egress. The Foster Shaft is a new work, the pit having been sunk in 1873. Owing to the presence of horse-backs in the mine, little progress has been made with the underground excavations.

The Osborne Shaft is an older and much more extensive mine. At the time the mining law went into operation, the mine had communication with the "old shaft" on No. 11 entry. The coal of the old shaft having been worked out, the pillars were attacked and withdrawn, and communication was hopelessly closed between the two mines about the beginning of February of the present year.

The south entry of this mine, called the dip entry, was, at the date of inspection, in a horse-back, for 200 yards. There is a trace of coal all the way. Coal of workable thickness was known to exist beyond this fault before it was entered.

The Kyle Bank is one of the best ventilated in the Mahoning Valley, and its main shaft is one of the safest and finest structures in the State. The second opening, as is usual in this valley, has a ventilating furnace at the bottom of it. When complaint was made last summer against the mines of this valley, in which there were no ladders in the second shafts, some of the mines applied iron ladders or sunk third shafts and put wooden ladders there, but none of the mine owners who had but two shafts, seemed willing to divide the upcast into two compartments, one for the escape of the smoke and gases, and the other for the exit of the miners in case of accident. Desirous of obtaining a legal decision as to the meaning of the statute in regard to the available means of ingress and egress, a trial was had against this mine before Judge Taylor, in Youngstown Court of Common Pleas, November 9, 1877. The following is the testimony:

TESTIMONY OF ANDREW ROY.

Andrew Roy, being called, on part of the State, testified as follows:

Q. You may state to the Court, Mr. Roy, if you are acquainted with the Kyle coal bank.

A. Yes, sir; I have been through the bank several times.

Q. When were you last through the mine?

A. My recollection is that it was three or four months ago.

Q. Was that before this suit was commenced?

A. I think it was some time before it; I cannot tell how long.

Q. How is the mine entered—by a shaft or a slope?

A. The mine is a shaft opening. It has an air-shaft which is the second opening. There was no ladder in the second shaft, or means of ingress or egress, when I visited it.

Q. How far apart are the two openings?

A. About two hundred and fifty yards.

Q. Do you know the depth of the two shafts?

A. The first is 180 to 200 feet deep; the second, 140 feet deep.

Q. What are the means of ingress and egress?

A. In the hoisting shaft, they have the best and safest means in the State; as to the second shaft, I understand they have a ladder in there now.

Q. How is the ventilation secured?

A. By a furnace at the bottom of the second shaft.

Q. Describe the furnace. How far is it from the bottom of the second shaft, and how much coal is burned on it?

A. The furnace is six feet wide, three and a half feet high above the grate bars, and ten feet long. It burns about 500 pounds of coal at once, when the fire is well kept up.

Q. How many men are employed in the bank?

A. I do not know positively; I have not counted them. [Conceded that more than ten men work in the bank, and that defendants own the bank.]

Q. Would a ladder, in the second shaft, be always available as a means of ingress and egress?

A. If the furnace was being well maintained, I do not think men could get out. The flame from the furnace would scorch them in passing into the shaft.

Q. If the fire were green, could men get out?

A. I think men would be suffocated by the smoke.

Q. Would not the gases from the coal suffocate the men?

A. I think not.

Q. What gases are formed from the burning of coal?

A. The deleterious gases are carbonic acid, and carbonic oxide. Carbonic acid is the product of the perfect combustion of the coal; carbonic oxide the result of imperfect combustion. I made a calculation, this morning, of the quantity of deleterious gases formed from the combustion of a pound of Briar Hill coal. I have not the figures with me; but I am perfectly satisfied men may pass through the shaft during an ordinary fire, without danger from these gases. A man might stay in the shaft half an hour before he would be overcome. The air is changed in the shaft every thirty seconds, and a pound of Briar Hill coal forms, in combustion, twenty-four cubic feet of carbonic acid gas.

By the Court.—Q. How long would it take a man to ascend the ladder?

A. He could do it in two minutes and a half, but he ought to have four minutes.

Q. What is the temperature of the air-shaft?

A. Well, I am sorry I have not made an examination with a thermometer, but, judging from examinations made at other shafts, I think it would not exceed 200 to 225 degrees at the bottom, and 150 degrees at the top.

Re-direct.—Q. Would not the iron ladder be too hot for men to take hold?

A. I think it would likely be too hot at the bottom, unless water is running down the shaft along side of the ladder to cool it.

Cross examined.—Q. What would you say, Mr. Roy, if there were a windlass with a carriage upon it to let down the second shaft, about men getting out safely?

A. Men could be got out that way.

Q. Do you know that there was a windlass there when you were there?

A. Yes, sir, I know there is a windlass there.

Q What would you say about the first opening being a means of ingress and egress at all times?

A. It is.

Q. The carriage is sometimes up?

A. When one carriage is up, the other is down.

Q. Suppose, Mr. Roy, as a matter of fact, that men had gone up the iron ladder while a fire was burning?

A. That would be the best of proof.

Q. Are you aware that men have gone up that shaft when a fire was on?

A. The fire might be low.

Q. How long would it take to draw the fire away?

A. Judging from an experiment made at the Weathersfield shaft, it would take about half an hour.

Q. What would you say about drawing the fire in ten minutes.

A. It would take about half an hour for the shaft to cool, so that men could go through it.

By the Court.—Q. How long would it take a hundred men to get out with a windlass?

A. About five hundred minutes.

Q. How long would it take a hundred men to climb the ladder?

A. There might be fourteen men on the ladder at once, each man taking four minutes to get out. You can calculate the time from these figures.

Re direct examined —Q Suppose, Mr. Roy, that a hundred men were in the mine, and the first shaft were to close, what would become of the smoke and gases in the furnace at the second shaft?

A. They would lay dead.

Q In your judgment, could a hundred men be got out alive under such circumstances?

A. I think not.

Q. Suppose an accident were to occur at the first opening, and the fire had to be drawn out the furnace before the men could ascend the ladder, could they all be got out alive?

A. If there was a good, cool fellow to boss them, they could be got out; but I think a panic would likely occur. The men would lose all self-control, and the result would be a catastrophe such as occurred at the Brookfield bank a few months ago.

Q. Do you think they would all be got out?

A. I think they would not.

TESTIMONY OF JONATHAN OATEY.

Jonathan Oatey being sworn, on part of defendant, testified as follows:

Q. What is your business?

A. My business is to superintend the Kyle coal bank.

Q. How long have you been at the business?

A. Five years at that shaft. I have been forty years a miner and a boss.

Q. What is your age?

A. I am now fifty-one years old.

Q. What facilities have you for men to get out and in?

A. We claim we have one of the best openings in the State.

Q. Have you more than one mode of egress for that bank?

A. We have two. Our shaft in case of egress and ingress is one hundred and forty feet deep, and in that we have a wire rope ladder which they can ascend or descend as fast as they want to. The ladder hangs about fifteen inches from the wall, and a man can put his back to the wall, or he can stop every fourteen feet on the buntings to rest.

Q. Is there any difficulty in going out or in with an ordinary fire?

A. No, sir.

Q. What would you say about the way of getting out being better by having a partition in the shaft?

A. I think it would be worse, as it would interfere with the air. We claim it would not suffocate men as bad as if they were in a close box climbing.

Q. How long would it take to draw the fire to get out?

A. Ten minutes We have done it in that time. There is one fire put on at six in the morning, one at eleven, and one at four.

Q. How long would it take with a fresh fire?

A Probably twenty-five minutes.

Q. When this coal is drawn out, what means have you of putting out the fire?

A. We have a stream of water under the grate bars, that the fire could be extinguished in a very little time.

Q What danger is there in getting out?

A. If the main shaft should close, we do not have to go that way to get to the upcast. We have a separate way around, called an air-way. It leads to the second opening.

Q. How long would it take a man to get up the ladder?

A. Four or five minutes.

Q. How many could go out at a time?

A. As many as could get on to it—fifty men.

Q. Had you any means of getting out before this ladder was put in?

A. We have an iron wheel windlass on top of the shaft. Some of the men get into the box three at a time. We took them out once at the main shaft.

Q. How long would it take to wind the men up?

A. It would take three or four hours.

Q. When was that windlass there?

A. We sank the air-shaft with it. It has been there ever since?

Q. How long does it take to bring them out of the main shaft on the carriages?

A. It takes fifteen minutes to bring out ten mules and a hundred men.

Q. How deep is the main shaft?

A. It is one hundred and eighty feet.

Q. How much longer would it take to get out by a windlass?

A. It would take a good deal longer?

Cross examined. Q. When was that wire rope ladder put up in the second shaft?

A. A out a month ago.

Q. Before this suit was commenced?

A. No, sir; I had not heard of the suit then.

Q. Do you remember when Roy visited the bank three or four months ago?

A. It was since that time.

Q. You said that fifty men could get on that ladder at once—do you still think that?

A. Why, I speak that way because they went up so in the old country.

Q. I want to know whether fifty men could get on to that ladder at once?

A. I don't know; but as soon as one man's foot left the round another could get on to it.

Q. How many men are there in the bank?

A. There are about a hundred men in the bank.

Q. How long would it take all to get out?

A. I do not know.

Q. How near is the furnace to the bottom of the shaft?

A. I should judge about eight feet from the center of the shaft?

Q. Would the blaze go into the shaft when it was in full force?

A. No, sir. I have been in there fifty times. We have three ways of getting to the flue. I could stay there as long as you please.

Q. Have you ever been up that ladder?

A. I have been down about half the distance. I never went through it. Some of the men have been through it, when the furnace was on and the fire was burning. When we put the ladders in, one day when the fire was built, I was down about eighty feet. The firemen built a fire, and the dust and ashes came up, and I hallooed to them to put it out.

Q. What opening was it you took the men out with a windlass?

A. It was through the other opening.

Re-direct.—Q. Coal diggers are not six feet tall, are they?

A. No, sir, not all.

TESTIMONY OF WILLIAM R. WILLIAMS.

William R. Williams, being sworn, on part of the defense, testified as follows:

Q. Where do you work?

A. At Kyle's Corners.

Q. In what bank?

A. In Kyle's coal bank.

Q. Do you know about the second opening?

A. I do.

Q. Had you anything to do with putting in the ladder?

A. I put them all in.

Q. Did you work all the time at it?

A. I could not work all the time, as we could not always keep the fire out.

Q. How was it when the fire was on?

A. I went in one day, and the man said there was no fire there; but I felt it a little warm, and I told the boys at the top to send me down to the bottom; there was a dead fire at the bottom, with coals about a foot thick.

Q. How would that fire compare with an ordinary fire?

A. There was plenty of fire there. I pulled that out right away, and went back to my work.

Q. How long would you stay?

A. Long enough to put in a bunting.

Q. Did you feel any difficulty from heat or gas?

A. No, sir.

Q. What, if any, difficulty, would there be in going up the ladder?

A. You could go up the ladder at any time when the fire was low, but not when the fire was fresh.

Q. How long would it take to pull it out?

A. About ten minutes.

Q. When did you work?

A. I was working as soon as I could get ready after the men quit.

Q. How soon could you go up after pulling out the fire?

A. We could pull the fire out in ten minutes, and go up.

Q. What benefit would there be to have a partition put in there?

A I had rather have it without it, as it would be too close.

By the Court.—Q. What do you mean by that?

A. It would close up on the air.

Direct.—Q. Would it be more difficult to go up?

A. I think I could go up easier now.

Cross-examined.—Q. Did you ever go through when the furnace was in operation?

A. I never went up with a fresh fire, but have with a dead fire.

Q. How long does it take to get the fire started?

A. I do not know.

Q. How much coal do you burn at a time?

A. I do not know.

Q. Could men get up there with a fire on?

A. The men could not get at that ladder when fire was there, of course—not when a big fire was on—on account of smoke.

Q. If you had a windlass to put twenty-five men on, would it not be better than that?

A. I never saw one so big as that.

Q. What is the diameter of this shaft where the ladders are?

A. I think, on the top, five or six feet; down about 100 feet, more narrow.

Q. The ladders that are at the bottom of it are pretty straight, then?

A. They are almost straight up and down.

Q. Are not wooden ladders the best?

A. You would not put them where the fire was.

Q. Suppose the air-shaft was twelve feet of area, and then a partition put in, would it not be better?

A. I have nothing to say about that.

Re-direct.—Q. You are satisfied with this arrangement?

A. Yes, sir.

TESTIMONY OF JOHN PRITCHARD.

John Pritchard, being first sworn, on the part of the defense, testified as follows:

Q. Where do you work?

A. At Kyle Shaft.

Q. How long have you worked there?

A. I have worked there between three and four years.

Q. Do you know about this air-shaft?

A. Yes sir; I work in the bank.

Q. I will ask you if men can pass up that wire-rope ladder when there is a fire on?

A. They could pass up better when the fire is out.

Q. Can they pass up when the fire is fresh?

A. I never tried it. I pulled the fire out when I was working on it. It was a red fire that was on when I was working in there once; it just needed fresh coal to make it fresh.

Q. How was it as to being an ordinary fire?

A. It had just gone so far as to need feeding.

Q. How long would it take to draw that fire?

A. We could pull the fire out in ten minutes, at the farthest.

Q. What, then, would prevent men going up the ladder?

A. I think we could go up the ladder then.

Q. What gases would there be?

A. There might be a stench from the fire, but that would come up the air shaft, and flow away with the air.

Q. How long would it take to go up?

A. I think I could go up in ten minutes.

Q. What do you say as to the partition?

A. I would sooner have it the way it is now.

Q. Is it a means of egress at all times?

A. Yes, sir.

Cross examined. Q. Did you ever come up when the fire was good?

A. No, I never did. I never saw any one come up then. When I saw any one come up there the fire was low.

Q. Was you ever at the bottom when the fire was on?

A. Yes, sir.

Q. What did you ascertain at the bottom of the shaft?

A. I do not know; it was warm; I staid there but a short time; the fire needed feeding.

Q. Could you stay at the bottom of the shaft when the fire was fresh?

A. I never tried it, but I believe I could go in at any time. I do not know whether I could go through there at any time, but I think I could.

Q. Suppose that there were a hundred men in the bank, and the first shaft is closed up entirely, could the men all get out?

A. In case the first shaft was closed up, the second shaft would not be an upcast. It might act as an upcast, as there is a current of air till all leakages are closed.

Q. Is it impossible that the first shaft should fall in?

A. If the down-cast shaft was to catch fire it would act as an upcast shaft.

Q. Suppose the roof should fall, so as to close it up, what would be the condition of the fire at the bottom of the upcast shaft?

A. It would still act as an upcast.

Q. Suppose it should close up tight?

A. The fire would lay there till put out; those gases would lay there.

Q. Under these circumstances, could not all get out, in your opinion?

A. I do not know; a man can not live without air. I think this way—that the air would be there a certain time after the current is cut off.

Q. Suppose the first shaft were closed up entirely, do you say that all the men could escape?

A. I should think they could.

Q. Would you risk it?

A. I do not want to.

Q. Suppose that air-shaft was made twice as large, and a partition made in the middle, a ladder on one side and the air-cast upon the other, would it not be better than the present arrangement?

A. I think it would.

Re-direct examined. Q. Is there any possibility that there could be a fall so that it would close up all the passages?

A. It might fall in that way, but it looks so strong that I think it will never happen.

Q. If the main shaft should catch fire, how would it be?

A. If the main shaft should catch fire, the current would come up there, drawn by the heat. It would draw the smoke from the flue right to the main shaft, and there would be no upcast at the second shaft.

Q. Is not there an air-current in the bank when the furnace is out?

A. If there is an outlet and an inlet there is.

Q. Will not an outlet take out air?

A. Well, I have seen the flame of my lamp turn sometimes. After the inlet is cut off, there is a circulation for some time.

Re cross-examined. Q You say the roof is pretty strong in that bank—were not two men killed there lately by the roof falling?

A. I mean at the bottom of the shaft.

By the Court. Q. How long have you been in this bank?

A. About four years.

Q. When was this ladder put up?

A. About two weeks ago, or more.

Q. If there should be an accident happening to the down-cast, would you have to put out the fire?

A. Yes, sir.

Q. You think it would take ten minutes?

A. Yes, sir.

Q. Suppose that there was a fire at the air-shaft, how long would it take to go up there?

A. I think it would take ten minutes.

Q. Could a man go up there at any time?

A. It depends upon the state of the fire.

Second re-direct examined. Q. Suppose the fire was not fresh?

A. They could go up.

Q. How much of the time is there in the bank that it is fresh?

A. I feed the fire twice—it is a green fire for twenty minutes or half an hour, and then it stands a red coal fire until it dies down again.

Q. How long after you feed the fire could you go up before drawing it?

A. I feed it at eleven. About half-past two you could go up the shaft. I do not say but what I could go at any time. I think I could go right up with a fresh fire.

Q. How long would it take to go up the ladder?

A. I could go up in five minutes.

Q. When you built up the fire, could you go out?

A. You could go up at any time?

Q. Did you ever see the blaze go near the shaft?

A. I never saw it go into the shaft.

TESTIMONY OF JOB WILLIAMS.

Job Williams, being first duly sworn, on part of defense, testifies as follows:

Q. Where do you work?

A. At Kyle's Shaft.

Q. How long have you worked there?

A. Two years in December.

Q. How long have you been a miner?

A. About twenty-eight years.

Q. What difficulty is there in passing up that air-shaft with the iron ladder there?

A. I do not know as there would be any difficulty only when a fresh fire was on.

Q. Could a man get out there with a fresh fire?

A. I never tried.

Q. What do you say as to this being a means of ingress and egress?

A. We have two ways of getting out at present.

Q. How is it as to being available at all times?

A. It is available at all times, because the ladder is there.

Cross-examined. Q. Have you been up and down that ladder often?

A. No, sir; never.

Q. You say a man might go up with a fresh fire.

A. I did not say it was safe. It is an iron ladder. There is a place called buntings that the ladder is fastened on to. The ladder is on one side and the shaft and the fire on the other.

Q. Do men usually have to stop to rest in going up?

A. They would have to.

Q. How long would it take to draw the fire?

A. About ten minutes.

Q. Suppose a panic should seize the men, what do you say as to its being a safe place to rest?

A. I should not say a man would have to stop every fifteen feet.

Q. Could men pass one another on the ladder?

A. Yes, sir; they could stand on the buntings.

Q. You say you do not think it would be safe to go up when the fire was on.

A. I did not say that it was not safe only when a fresh fire was on.

Q. How long after a fresh fire was put on?

A. I can not say how long it would take. They put on coal twice a day—once at eleven; then at four; sometimes in the morning.

Q. What do you work at?

A. I am a miner; I work in the air-way.

Q. How often do you see it?

A. I see it about once in a year.

Q. When did you see it last?

A. Not very long ago.

Q. How long is that?

A. I think last spring.

Q. Suppose that by some means the first shaft should close up by caving in, would the men be apt to escape?—would you consider it safe?

A. That would depend whether the downcast would be closed entirely.

Q. Suppose it would be closed entirely, would it be safe?

A. They can always work a little after the air is cut off.

Re-direct examined. Q. Suppose the air-shaft is closed up, would there be any reason for any great sight of panic among the men?

A. I suppose they could get out without any great hurry.

Re cross examined. Q. Would there be any panic?

A. No, sir.

Q. Have you ever been in an accident?

A. I have.

TESTIMONY OF WILLIAM M. WILLIAMS.

William M. Williams, being first duly sworn on part of defense, testified as follows:

Q. How long have you worked at the Kyle Coal Bank?

A. Four years.

Q. Are you acquainted with the air-shaft?

A. I have never been at the bottom; I have at the top; I have seen the iron ladder.

Q. What is your opinion about getting up the ladder at all times?

A. I think I can go up at any time. I knew nothing about the heat at the bottom.

Cross-examined. Q. You never have been up that ladder.

A. No, sir; I have heard of Williams going up it.

Q. When men go up and down, they go up and down the other shaft.

A. Yes, sir.

Q. It is about half a mile from where the men work to the shaft.

A. It is.

Q. Suppose that something would happen that you could not get up and down the first shaft, would a hundred men get up that ladder in safety?

A. That would depend on what kind of men they be; some would go up.

Q. Would you dare to go up there at all?

A. Yes, sir; I have been up ladders that distance.

JONATHAN OATEY RECALLED.

Jonathan Oatey, being recalled by the defense, testified as follows:

Q. Is there any chance for any accident that by any possibility can cause a panic?

A. I do not think there can be; the shaft is solid rock, one hundred and eighty feet, and nothing taken out from under it so that it can cave.

Q. What could happen in that bank that would compel men to go out of the second opening?

A. Nothing, unless some of our machinery gives out.

Q. Suppose that men are huddled at the first shaft, how long would they have to wait to be wound up by the windlass?

A. There are men in our shaft to-day that would not wait half an hour, but would go for the ladder.

Q. What is the structure at the top?

A. It is wood.

Q. What is the crib?

A. It is wood for eighteen feet.

Q. Might not it catch fire?

A. It might.

Q. Would it not cause a panic?

A. No, sir.

Q. Suppose there is an explosion of gases that would blow it up.

A. But there is not gas enough in the Mahoning Valley to blow it up.

Defense here rests.

TESTIMONY OF CHARLES WILLIAMS.

Charles Williams, being sworn on part of plaintiff, testified as follows:

Q. Where do you work?

A. In Kyle's Shaft.

Q. Where do you work in the bank?

A. In the entry called Ferren's entry, the other side of the bank of the air-shaft.

Q. You are acquainted with the air-shaft.

A. I used to work by the side of it.

Q. In your opinion, could a man go up through that shaft when there was a fire on?

A. I do not know; I would not like to go up.

Q. Do you think a man could go up?

A. I do not know; I do not think I could.

Q Do you think you could when the fire was low?

A. It might be; but I should want it out if I was going up.

Q. Do you think it would be safe?

A It would be dangerous.

Q Suppose that anything should happen in the main shaft, could a hundred men in the shaft all get out?

A. I think if the fire was put out they might get out.

Q. How long would it take to put the fire out?

A. Perhaps two or three hours to get it cool.

Q. Would it be that long before they could get through the shaft?

A. They might go through in less time than that.

Q. In case the present or main shaft was closed, so that there was no draft through the shaft, would not the smoke from the fire scatter through the mine, rendering it impossible for men to live?

(Objected to.)

Q. What would become of the smoke and gas?

A. It would have to lay there.

Q. I understood you to say that a hundred men could not get out through there?

A. I do not know about that, but I think probably they could not.

Q. What is your opinion?

A. Pretty hard for me to say; if men were trying to escape they might do it; but the fire would have to be put out.

Q. Do you suppose they could escape?

A. I would not like to try it.

Q In case this shaft was enlarged and a partition put through the middle, would it be easier for men to escape?

A. I certainly would.

Cross-examined.—Q. Are you acquainted with the way that furnace is put in?

A. No, sir, only in seeing it go by.

Q. Do you know that there is a pool of water there?

A. No.

Q. Do you know about the circulation of air in the bank?

A. Not very much.

Q. You know it comes in at one shaft and out at the other?

A. Yes, sir.

Q. Do you not know that they can put the whole current of air up the shaft without going through the furnace?

A. No, sir.

Q. How long would it take them to cool it off?

A. It would not take long.

Q. You say you would not like to go up there with the fire on?

A. No, sir.

Q. You do not say a man might not go up there under any circumstances?

A. I do not know about that.

Q. Do you not think men could go up in ten minutes?

A. I do not know.

Q. Would you not rather go up on the carriage?

A. Yes, sir; I had rather ride any time than walk.

TESTIMONY OF EDWARD COX.

Edward Cox, being sworn on part of the plaintiff, testified as follows:

Q. What is your name?

A. Edward Cox.

Q. Where do you work?

A. In Kyle Shaft.

Q. How long have you worked there?

A. Five years next March.

Q. How long have you been a miner?

A. Every since I could do anything.

Q. How much experience have you had in other banks?

A. I have not had a great deal.

Q. Where do you work in this bank?

A. In No. 1, side in the far end.

Q. Are you often in the neighborhood of the second shaft?

A. I know where it is located.

Q. If no fire is on you could tell, couldn't you?

A. Yes, sir.

Q. When the fire is on in the furnace, when the bank is in operation, can a man pass up that ladder?

A. I suppose I could go up there myself. I have gone up a ladder further than that with a fire on.

Q. How does it affect a man with a fire on?

A. I have been up Kimberly's Shaft, in Sharon.

Q. What was the stage of the fire when you went up?

A. It was fresh.

Q. Suppose the first shaft was closed up, could all the men get out alive?

A. I do believe the majority of the men could get out, all of them if the fire was not too big.

Q. Was you ever in a bank when there was an accident?

A. Yes, sir; men would rush out.

Q. Taking that into consideration, could a hundred men get out with a fire in the furnace?

A. I could not say; I think I could get out myself; but I would not want to vouch for any one.

Q. How large is the Kimberly Shaft?

A. I do not know.

Q. How does it compare with this shaft?

A. It does seem to me as if it was as large as that.

Q. Is not this a smaller shaft than is usual in banks?

A. I cannot tell, because I do not know what the regulation is.

Cross-examined. Q. How long would it take to pull the fire out?

A. I could pull it out in five minutes.

Q. What difficulty is there?

A. There might be a little smoke for a few minutes; a man could be out of the smoke in five minutes.

TESTIMONY OF PATRICK LENNON.

Patrick Lennon, being first duly sworn on the part of plaintiff, testified as follows:

Q. What is your business?

A. A miner.

Q. Where do you work?

A. In Kyle's Bank; have been there about eighteen months.

Q. What do you say when there is a fire in the furnace, and gases and smoke escaping, could you get up there?

A. From the experience I have had myself, I would not like to try it myself.

Q. Suppose the main shaft was closed up, could all the men escape?

A. It would depend upon the accident, and upon the excitement, but where there is any suffocation I cannot say.

Q. You may tell what you think about it—whether all the men could get out.

A. I would not be so afraid myself as I would of others.

Q. In your opinion?

A. Sometimes they could get up, but I would not vouch to say they could all escape; besides the excitement, gases create a panic sometimes, and then the gases are bad going up the ladder.

Q. What banks have you been in?

A. I have been up Kimberly's Shaft when there was a fire on, and there was a good deal of sulphur.

Q. How does it compare with this one?

A. It was the full size of twelve feet one way, and six or seven the other.

Q. The larger the shaft the greater the air?

A. The greater the size, the more the smoke would scatter.

Q. Can you give your opinion about the men getting out?

A. When there was any circulation, they might get out; but when there is not, I do not know.

Cross-examined. Q. With everything as favorable as possible—with no furnace at the bottom—might there not be an accident, and some be left? With one hundred men, might not some be left in there?

A. There might be.

Q. If there was no panic, might not some be left in there?

A. There might, under the circumstances.

ANDREW ROY RECALLED.

Andrew Roy, being recalled by plaintiff, testified as follows:

Q. Are you acquainted with the Kimberly Shaft?

A. The Kimberly Shaft is eight by sixteen feet; the furnace is in that shaft, and

the smoke and gas escapes and spreads over all that surface; I have worked in that shaft myself, and have gone up the ladder.

Q. In regard to a partition in the air-shaft, what do you say?

A. The shaft would have to be enlarged to be safe. The partition would shut off the gas and smoke; one side would be used for the miners, and the other for the smoke, so that the men, under all conditions, could go out, and it would be a much safer means of exit.

***Cross-examined.* Q. I suppose that, by the use of time and money, this company could take them out on a palace car, could they not?**

A. Yes, sir.

JONATHAN OATEY RECALLED.

Jonathan Oatey, being recalled by plaintiff, testified as follows:

Q. You have already stated this bank has been in operation several years?

A. Five years.

Q. How far are is it from one entry to another?

A. About a quarter of a mile.

Q. In the whole bank, has there been more than fifteen thousand cubic yards excavated?

A. I think not; I am merely the bank boss, and have nothing to do with the business.

COLUMBIANA COUNTY.

The works of the Cherry Valley Iron Company, consisting of three mines—two drift openings, situate at Washingtonville, and one slope, at Leetonia—were visited and inspected during the month of July. There is furnace ventilation at the slope, and a fire is kept up in an iron basket at the bottom of a shallow air-draft at the upper drift, but the lower drift relies on the natural forces. A series of butt entries are opened off the main entry, and the air is split at each of the butt entries in the lower drift mine, each entry getting its proportionate share of air. This practice ought to be applied at all the mines; for, owing to the low workings—the coal being less than thirty inches in height—the men have to come out to the entry and rest. A rapidly moving current of air chills the miners, the floor of their working places being damp, and sometimes wet. Usually, there is a fair state of ventilation prevailing in the mines of this company. No gunpowder is used for blasting coal, aad there is no annoyance from powder smoke. The system of mining in practice in this district was described in detail in my last annual report. The mines are well managed. The mining superintendent, Mr. Zachariah Titlow, has been in charge of the works for twenty years, and has grown gray in the business.

The mines of the Grafton Iron Company were visited, but were not working at the time, and were not inspected. The seam of coal is the same as that operated by the Cherry Valley Iron Company. The Grafton Iron Company has erected a crusher at the top of the pit, through which the coal is passed and ground up before being dumped. A better coke is made by this arrangement. There are two seams of coal in the shaft of this mine, though the lower bed, which is forty to fifty feet below the upper one, is not now mined. These two coals are called Nos. 3 and 4, following the names given by Dr. Newberry, in a survey made in the year 1857. As the upper coal is overlaid with a stratum of blackband ironstone, and both seams have beds of limestone lying below the coal, conditions which often belong to Coals Nos 6 and 7, it is not improbable that these coals are really Nos. 6 and 7, instead of Nos. 3 and 4, and are the equivalents of the two coals, the "lower and upper veins of East Palestine."

Walters' Mine is another work of the Leetonia district. The mine, originally opened on the Long Wall system, has been changed to pillar and room work, after the plan in use in the district. I went through the workings with the mine boss in July last. The work was being put in good order.

The Salineville district was visited during the month of September, but before all the mines were examined, I was called to the Mahoning Valley, on a suit against one of the mines there. The Foster Big-Vein Mine was visited and found in good order. The strip-vein opening was working less than ten men, and was passed over. The mines of Granage and Anderson were also visited, but were not working that day, and were not inspected. The Farmer Mine was visited and inspected. It was working a small force of men, and all the working places had good air.

A new shaft has recently been sunk, below the village of Salineville, to the big vein coal; the shaft is forty feet deep. The coal in September last had only been reached, and the machinery for hoisting was not completed.

The coal of the strip-vein of this district, though of a superior quality to that of the big-vein, has been nearly driven out of the market by the latter, by reason of its lesser cost. Only three or four mines were shipping strip vein coal, and all were doing a feeble business, while the big-vein mines were running at their full capacity.

The mines of the Ohio and Pennsylvania Coal Company, situate at Salineville, are known as the Jones Mine, the Hays Mine, and the Empire Mine. The Jones and Hays Mines are really one colliery, both openings fronting the creek within 150 or 200 yards of each other, and the mine excavations extending forward in one range of work. The air is received at the upper mine and discharged through an air-shaft in the lower one, at the bottom of which the ventilating furnace is placed.

There is now an abundant flow of wind in these mines, and so long as it is properly distributed there cannot arise a complaint of bad air. The rooms were all well aired except two or three, which had been opened before the air-course of this part of the mine was through on the entry. Formerly there was no artificial ventilation in these mines. The current was always weak, and the miners suffered from the foul air in their working places Now all is changed; these underground workshops are visited with a pure and sweet atmosphere. Where there was formerly grumbling and fault-finding on the part of the miner, there is now respect and gratitude. The Empire Mine was not visited. It has also an air-shaft and ventilating furnace. The Hays Mine, below the Empire, was also not visited, but it was reported as being in good condition.

The mines of the Prospect Hill Coal and Mining Company, situate at East Palestine, consist of two mines, each opened on different seams of coal. The "Lower Mine," opened on Coal No 6, is reached by a slope, sixty feet in length and dipping one foot in three This mine is not working at present, and has been idle since the fall of 1875. At the date of visit, August 1st, the bank was full of water, the pumps having previously been taken out. On the southeast side of the hill, however, a level free drift was in progress, to cut through the main entry, and thus provide natural drainage.

The "Upper Mine," opened in Coal No. 7, fifty feet above the horizon of Coal No. 6, is level free, and enters the hill in a south-western direction. The main entry, which is a face entry, quarters on the butts; it is seven feet wide, and runs through the hill. The cross entries, also seven feet wide, run on the butts to the east and west. These entries are seventy five yards apart. The rooms, when opened to full width, are twenty-one feet, but are started off the entry at seven feet. The coal is mainly got by knocking, though a blast is sometimes necessary. The ventilation is by the natural forces, the entries, which are about 600 yards in length, running out to day. An air shaft is sunk near the entrance of the main entry. A furnace placed at the bottom of this shaft would greatly improve the ventilation.

During the past year a shaft was sunk by the Prospect Hill Mining Company, in a low ravine, on the south-west part of the mining property. About one hundred and forty-one feet below the horizon of the lower coal, at the depth of thirty-one feet from the surface, a seam of coal was met, which proved to be four feet eight inches thick. The quality of the coal, however, was worthless, being a bed of coal and slate in a heterogeneous mass. This coal is about two hundred feet bolow Coal No. 6, and is probably Coal No. 4. I advised sinking still deeper, to see if another and better bed could not be met.

The State Line Company's Mine, situate at East Palestine, is opened, as its name indicates, on the State line dividing Pennsylvania and Ohio. The main opening is in Ohio, about fifty feet from the State line, and the main entry runs due south, on a line parallel with the State line for nearly half a mile. Thence this entry wheels to the west about twenty degrees. There are eight butt entries on the west side of the main entry and seven on the east side. These entries are each one hundred yards apart, the rooms working on both sides and meeting in the middle. All the room-workings opened on the east entries are in the State of Pennsylvania, and all opened on the west entries are in the State of Ohio. The butt entries are numbered on each side of the main gallery, and are known as the first left, second left, third left, etc.; the first right, second right, third right, etc. On the west side of the mine a horse-back, consisting of a mass of sandstone, cuts out the coal in the sixth and seventh right entries. This fault is cut through on both entries, and is less than two hundred and fifty feet in thickness. It is not touched either on the fifth right or on the eighth right, and appears to be a mass of sandstone usurping the place of the coal in the shape of an oblong 0.

The mine was opened in 1874, and has done a very extensive business since coal shipments commenced, a force of men, nearly two hundred in number, being regularly employed. The main entry is double, but the butt entries were opened on the single plan, doors being erected at the mouth of each room to get forward air. This method of ventilation is being abandoned, and double butt entries introduced, which do away with doors, and provide a more vigorous ventilation at the working faces of the mine. On the seventh left entry an air-course has been driven southward to day, and the air is now received at this opening. During the summer an air-shaft was sunk and a furnace built. The air, secured at the south opening, is carried to the face of the eighth right entry, thence it passes to the seventh, thence to the sixth, thence to the fifth and fourth, whence it is transferred to the working entries on the Pennsylvania side of the mine, and delivered to day through the air-shaft. A number of butt entries, on both sides of the mine, have been finished and the rooms wrought out.

TUSCARAWAS COUNTY.

The Pike Run Mines of the Tuscarawas Valley Coal Company, Nos. 1 and 2, are situate three miles north of Urichsville, on the Cleveland and Tuscarawas Valley Railroad. The main entry of No. 1, the upper mine, passes through the hill. This second opening is the intake. The air, after being received at this opening, is split into two columns by a door on the main entry, one column consisting of four thousand cubic feet per minute passing along the break-throughs on one side of the entry, and the larger column, consisting of eight thousand cubic feet per minute, passing along the break-throughs on the opposite side of the entry. The ventilating power of this mine consists of a "Champion Fan," located near the entrance of an air-gallery. This is a double fan, consisting of two blades, working on one shaft, each blade being four feet in diameter. The fan is so arranged that it can be reversed, and either blow the air into the mine, or exhaust it out of the mine. Blowing, or forcing-fans, however, especially in extensive underground workings, are not adapted for mine ventilation. The "Champion Fan" is a recent invention, this being the first one applied in this State, and one of the first applied in any State. As our shallow mines are not well suited for furnace ventilation, and as a good exhaust-fan is a cheaper, more powerful, and more reliable ventilator than a furnace, every mine in the State would be benefited by substituting the fan for the furnace as a ventilating power.

Mine No. 2, at Pike Run, works a small force of men, and is rudely ventilated, an iron basket being suspended in a shallow wooden box, which is made to serve as an upcast. During the summer, the fire in the basket set the woodwork on fire, and burned it out; but instead of improving on the old concern, the manager set to work and duplicated it. The miners, when the mine was visited, were working in rooms turned off both sides of a butt entry, near the mouth of the drift. These rooms were worked forward, in some cases, two hundred and fifty to three hundred feet, the feeble current of the mine passing directly along the entry to the upcast. In the language of one of the miners, who wrote me complaining about the condition of the mine, "there is not fresh air enough in the mine to supply a rat." This mine was about being abandoned, and these cheap ventilating fixtures were erected as temporary expedients. This company deserves credit for introducing fan ventilation in the State, and the superintendent has always expressed a desire to make any reasonable improvements for the salubrity of the mine.

The Stillwater Mine of the Tuscarawas Valley Coal Company No. 3, situate at Urichsville, which has been idle for three years, was started up again during the summer, and is now employing from sixty to seventy underground workmen. The mine has been thoroughly overhauled. The old timbering was taken out, and new and strong timber substituted at the entrance of the mine. The old roads have been taken up, and new roads, laid with T iron, put down. The air-courses have also been fixed up, but the ventilating power is too weak, and insufficient for the requirements of the mine. It consists of an iron basket suspended at the bottom of the air-shaft. When the fire is well maintained, between 2,000 and 3,000 cubic feet of air per minute can be moved through the mine. I have notified the owners of the mine that better ventilating arrangements are needed in conformity with the requirements of the mining law. A five-foot furnace placed at the bottom of the air-shaft, if properly constructed and well maintained, could move ten thousand cubic feet of air per minute. The air-shaft, which is eighty feet deep, is dry throughout. The mine owners propose applying one of the Champion Fans with which to ventilate the mine.

Andraes Mine, at Urichsville, enters the hill on the south, and runs to the boundary of the mining property, 2,240 feet from the mouth of the mine, on the face of the coal. The butt entries, a number of which have been worked out, are 335 feet apart. They run on both sides of the main entry to the boundary, those on the east side advancing about 2,000 feet, and those on the west side 1,000 to 1,200 feet. The interior butt entries were all worked first, and the interior coal of these entries was first attacked, the mine being laid out in a series of blocks or squares by driving face, or air, and drainage galleries from one butt entry to another. This plan of laying out the mine was suggested to avoid the expense of cutting and removing the coal floor, which in this district is a soft and fragile fire-clay, disposed to heave up in the entries, even when there is no weight on the pillars. It has the additional advantage, also, of dry roads, as the advanced entries and air-ways drain the water off the coal. Moreover, all the coal can be removed, while the crushes which follow the extraction of the pillars are powerless for mischief.

In working out the coal, rooms are worked on each side of the butt entries, meeting in the middle of the block. One block is worked out, and all its pillars removed, before another is attacked, and hence rooms are never worked on both sides of the butt entry at once. The entries are made seven feet wide, the rooms are staked off six feet wide, but are enlarged to twenty-five feet after they have advanced twenty feet; a pillar eleven feet in thickness is left between each room. Break-throughs or cross-cuts are made from one room to another every one hundred feet.

In working forward each butt entry to the boundary of the coal property, an air-shaft is sunk at the back of the entry, and thus the air passes direct from the intake to the working entry, thence to the upcast. The falls of the overlying strata liberate black damp, and sometimes even with these air arrangements the ventilation is none too good. Much better and cheaper results might be had by having but one single air-shaft, located near the outer butt entry face, and a large and powerful furnace placed there. By the present plan the air-shafts, located at the face of each butt entry, are lost in the crushes which follow the extraction of the pillars. These air-shafts are, however, generally very shallow. This is an advantage as far as the cost of sinking is concerned, but the deeper the shaft the more powerful the ventilating current.

On the mineral property of the Glasgow Port Washington Iron and Coal Company, Coal No. 7, the seam which forms the roof of blackband iron-stone, is seventy-four feet above coal No. 6. The coal is very impure, being heavily charged with iron pyrites and other impurities, and
or home fuel is of little or no commercial value. No. 6 was
nd mined before the Scotch company purchased the property.
mine, opened on the outcrop of this coal, dipped rapidly, and a
ing, commenced about fifteen feet below the coal, caught the
amp one hundred yards from the entrance of the mine. A
try quartering on the face of the coal follows the dip in a north-
e. In this hollow the coal enlarges to eight and nine feet, but
dly on taking the hill. So far as this mine has been worked,
as been pushed over the hill into an adjoining hollow or dip,
of the hill has been reached in several working places, fifteen
feet above the swamp. The seam on the swamp recedes five
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rizontal plain. The side of the old trough is marked by a
clay.

dation of the blast furnace stock-house rests on Coal No. 5,
eing here about two feet in thickness; its horizon is about
elow No. 6. No. 5 has been opened at several points, and
ed some distance in the hill. The coal is reported to be of
osition, dwarfing to a few inches and enlarging to three fee
posite the furnaces a drill hole 123 feet in depth was
the former manager, two years ago, and in the summ
year three holes were dr
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On the mineral property of the Glasgow Port Washington Iron and Coal Company, Coal No. 7, the seam which forms the roof of blackband iron-stone, is seventy-four feet above coal No. 6. The coal is very impure, being heavily charged with iron pyrites and other impurities, and except for home fuel is of little or no commercial value. No. 6 was opened and mined before the Scotch company purchased the property. The old mine, opened on the outcrop of this coal, dipped rapidly, and a new opening, commenced about fifteen feet below the coal, caught the dip or swamp one hundred yards from the entrance of the mine. A branch entry quartering on the face of the coal follows the dip in a northeast course. In this hollow the coal enlarges to eight and nine feet, but thins rapidly on taking the hill. So far as this mine has been worked, no place has been pushed over the hill into an adjoining hollow or dip, but the top of the hill has been reached in several working places, fifteen to twenty feet above the swamp. The seam on the swamp recedes five feet, occasionally dwarfing to four and one-half feet.

The trough in this mine where the unusual thickness of coal is met has been scooped out of the old plain before the coal was deposited˙ Along the entry from the swamp towards the mine mouth, where the coal floor has been taken up to make the road level, the coal seam and the two and one-half feet of strata immediately below it are observed to rise rapidly, while the strata below, composed of layers of sandstone, occupy a horizontal plain. The side of the old trough is marked by a layer of fire-clay.

The foundation of the blast furnace stock-house rests on Coal No. 5, that seam being here about two feet in thickness; its horizon is about thirty feet below No. 6. No. 5 has been opened at several points, and entries pushed some distance in the hill. The coal is reported to be of irregular deposition, dwarfing to a few inches and enlarging to three fee In a hollow opposite the furnaces a drill hole 123 feet in depth was [illegible] by Mr. Rennie, the former manager, two years ago, and in the summ of the present year three holes were drilled by Mr. Solon Baily, one of the most intelligent coal-drillers in the State, under the supervision of Mr. Lawrence H. Watson, the present superintendent of the company.

The Mayer's Mine, Bowen Brothers, lessees, formerly the Saunders Mine, and an opening on Judge Armore's farm, one mile eastward, are each opened on the same seam of coal. This seam is called No. 6 in the geological reports. Its position is only twenty feet above the gray limestone. In the two air-shafts of the mine of Bowen Brothers, a seam of coal about a yard in thickness is passed through. It is sixty-four feet above the main coal in one shaft, and forty feet above it in the other, these shafts being about 300 yards apart. This upper coal is not due on Judge Armore's land, for want of mountain height. If the main seam is Coal No. 6, this upper bed will represent Coal No. 7.

There are numerous small mines in Holmes county, which raise coal for local consumption. They usually work from two to six men in winter, and in summer are idle. Only two mines, the Mayers and the Hardy Mines, have shipping facilities, and the Hardy is now idle. The Mayers bank, operated by Bowen Brothers, works from fifteen to twenty-five men. The mine is level free, and is operated high up in the bluffs, on a seam of coal ranging from three to six feet in thickness. In addition to the day level, there are two air-shafts, respectively ninety and forty-four feet deep, the deeper shaft having a ventilating furnace.

The main entry of Bowen's Mine, which is on the face of the coal, runs north-west in a swamp. This swamp is only about twenty-five yards wide, the coal rising on both sides. The rise is very gradual at first, but becomes more rapid, fully twenty degrees, as it approaches the hill-top. In the swamp there are six feet of coal; on the hills, which are thirty-one feet high, the seam has dwarfed to two and a half feet, losing height mainly from the bottom of the bed. The rooms of the mine have in no case been pushed over the hill into the adjoining trough, for in dipping over the hill they make water, and are stopped to avoid the cost of bailing. The coal shows as marked inequalities of level in the floor of the bed as many of the mines opened on Coal No. 1 in the Mahoning and Massillon regions.

This mine was visited in January, by request of the lessees, part of the old workings on the right of the main entry being on fire. The fire originated among the slack pile in the gob, from the pyrites of iron in the coal. I advised the lessees of the mine to shut it up, and hermetically seal it for two or three months as the sure means of extinguishing the fire, which had now got so far ahead that unless extinguished it would, in the course of a few weeks, drive the miners out altogether. The lessees, who were hard-working, practical miners, could not well afford the loss of time, and continued working the mine until the first of April, by which time the fire had got into the entry pillars and was burning them up.

On the first of April, Messrs. Bowen Brothers withdrew the cars from the mine, and closed the air-shaft and drift mouth, filling in a solid wall of clay four feet in thickness. The mine was then shut up from the air until the eighth of August, when it was reopened. It was now a vast magazine of black damp. Owing to the atmosphere outside being lighter than the mine air, the air-shaft drew down. Water was also poured into the air-shaft to aid the natural current, and in twenty-four hours the black damp had been so far removed and the fresh air so far renewed that it was possible to carry a light to the bottom of the air-shaft. The furnace was lit up, and the ventilation reversed. With the change of draft the gases were drawn out of the waste workings, and some of the miners were nearly overcome by the foul air. An examination of the mine after the ventilation was renewed, showed that the fire had immediately gone out with the closing of the mine. Unless that part of the mine which took fire is shut off from the air current, I think the fire will break out again. There must either be a powerful column of air passing over this part of the mine, or it must be hermetically sealed from the air.

CAMBRIDGE MINES.

The Cambridge Mines, consisting of the Norris Shaft, the Scott Mines, the Company Mines, the Guernsey Mines, and the Nicholson Mines, were inspected in November.

The Norris Shaft has but one butt entry running, No. 3 (which is a double entry, a twenty foot pillar separating the parallels), Nos. 1 and 2 being worked out. Nearly all the underground force were at work in rooms opened on No. 3. The air was good throughout the mine. A new butt entry (No. 4.) will be opened shortly. The rooms in this mine are made twenty feet thick; the pillars between rooms are also twenty feet thick, and no pillars have yet been drawn. It is proposed to commence at the interior of the workings and attack the pillars after all the rooms are finished.

Scott's Mines have been improved by laying the main hauling roads with T iron. This is the best, and, in the long run, the cheapest, method of laying track in a coal mine; and all roads—rooms as well as entries—ought to apply T iron as a measure of economy. A new air-draft and ventilating furnace were constructed at the face of the main entry during the summer. The shaft is forty-five feet deep; the furnace is well constructed, and is aided by the heat from the steam boiler of the pumping apparatus, erected along side of the furnace, this point being the lowest part of the workings. The air-shaft was sunk through clayey material all the way; yet, four feet to the north and west, the shale was found in place from the top downward, showing that the shaft went down on the edge of an ancient ravine, now filled with drift material. The top of the air-shaft has no chimney, and during windy weather the air blows down, reversing the ventilation for the moment. Unless a chimney stalk is soon provided, a fire will occur at the bottom of the shaft some day, which may spread to the coal, and entail an expense of perhaps hundreds of dollars in getting it out. Then will be realized the full extent of the old maxim, "a stitch in time saves nine."

The workings of Scott's Mine, on the west of the main entry, are holed through on the eastern workings of the Company's Mine. The air used in ventilating both of these mines is received at the Company's Mine, passed through the Scott's, and is delivered to day through the furnace shaft at the head of the main entry in Scott's workings.

The Company Mine of the Cambridge Coal and Mining Company has ur butt entries working on the east side of the main entry. They are known as the Rock entry, the Scott entry, the Booth entry, and the Howery entry. A fifth is just starting at the face of the main entry. hese entries are one hundred and twenty-five yards apart, rooms working off both sides. The rooms are twenty feet wide; pillars between rooms ten feet thick. The Scott and Howery butt entries are double, a twenty foot pillar separating the parallels. The main entry is also double at the interior. All the workings at the present time are on the butt entries which run eastward.

The air of this mine at the face of the main heading and in the rooms in the interior cross-headings, was not good. The air is moved, as I have said, by the furnace in Scott's Mine. The greater part of the current is drawn from an opening east of the main entry, and the air, after passing along the outer-working cross-entries, flows direct to Scott's workings. I called the attention of the superintendent to the necessity of improving the air, which can be done at a very trifling expense.

The Nicholson Mines were in good order. The air is received at the main entrance, and is split into two columns at the mouth of the first butt entry running westward, part going to an air-shaft recently sunk at the face of the first west entry, and part to the old air-shaft. All the men, with one or two exceptions, are at work in the first west entry. This mine, although its workings are far from extensive, has suffered from the effects of having too weak pillars. Two entries were lost last year by creeps, and one of them had to be opened up anew after the roof and floor had crept together, in order to get at the coal beyond the reach of the creep. In Smoky Row entry, part of the roof crushed and fell down to the surface during the progress of the creep, and opened up feeders of water which flowed back into the mine excavations. This water is at present dammed back from off the hauling entries, and an entry is now being driven to day, in a swamp or low place in the mine, to drain the pent-up water. In the mines of this district, all of which have a soft and yielding fire-clay floor, fully one-half of the coal ought to be left in the pillars, the greater part of which could be recovered in working home.

The Macksburgh Mines, the mines on the Muskingum River, and the small openings situate at Zanesville and along the line of the Muskingum Valley Railroad, were not visited during the year. These are all level, free openings, and the greater portion of them work less than ten miners at once. A number of them are understood to be very poorly ventilated—so poorly, indeed, that during the summer months the black damp sometimes accumulates and drives the miners out. Mines which work less than ten men at once do not come under the requirements of the mining law, unless on application of the mine owner or the miners. I have never received any complaint from those inserested in working these small mines.

HOCKING VALLEY MINES.

The mines of the Hocking Valley were visited and inspected at different times during the year. The plans of working in practice in this district were fully described in my last annual report. Some marked improvements have been made at several of the mines. The Hayden Mines were visited during the summer. All the openings are ventilated by the natural forces. Some of the newer entries, extending under the hills, without a chance to drive out to day, will require special ventilation by furnace or other power. The air is carried round the mines by dividing the workings into panels and driving the main entries, either on the face or butts of the coal, out to day.

Scott's Mine, situate at Lick Run, is the second in descending order of the series opened on the line of the Columbus and Hocking Valley Railroad. It is ventilated by furnace power. The air-shaft was formerly a wooden structure, erected at the entrance of one of the openings, at the bottom of which an iron basket was kept burning. The basket was supplanted by a furnace, and the wooden shaft by one constructed of brick. The brick shaft, formerly but twenty feet high, has now been extended to sixty feet, and seven thousand five hundred cubic feet of air is moved through the mine.

The Laurel Hill Mine, also situate at Lick Run, usually works a small force of men. The mine has two main openings and an air-shaft. The ventilation is by the natural forces, the air coming down the shaft and discharging itself at the drift mouth during the summer months, when the atmosphere outside is specifically lighter than the mine air, and entering by the drift mouth, and escaping by the air-shaft, in winter, when these conditions are reversed. There should be a good furnace built at the bottom of the air-shaft, to insure a constant flow of air at all times and seasons.

The two mines of W. B Brooks & Son, situate at Nelsonville—one in Hocking county, in section 19, and the other in Athens county, in section 29—are now both working with a full force of miners, though during the greater part of the season the force of section 29 was greatly reduced. These mines are also ventilated by the natural forces. The plan of working, consisting of driving the entries out to day into some of the numerous ravines, and of driving air-courses from one butt entry to another, and dividing the workings into panels or squares, was fully described in my last annual report.

A new dump, or tipple, has recently been introduced for dumping coal at section 19, the invention of J. L. Mitchell, one of the miners. This dump is skillfully got up, and is one of the best arrangements for dumping loaded cars I have ever seen used at a coal mine, saving labor and coal at the same time. It is so constructed that the loaded car, in passing into the tipple, dips over of its accord, its force or speed being regulated by a brake, the handle of which is within easy reach of the dump-man. As soon as the car is emptied it falls back in place, and the tip irons are thrown out of place by a spring acted upon by the advancing loaded car, so that when this car strikes the empty one standing on the tipple, the latter is pushed forward out of the way. The tip irons then spring back to place to receive and hold the loaded car, which dumps of its own accord, falls back when emptied, and is pushed out of the way by the next full car. All the arrangements are nearly automatic in their operations.

Four mines, all situate in Athens county, namely, Paston's Mine, the Coöperative Mine, the Floodwood Mine, and the Hawley Run Mine, were complained against during the summer, by reason of defective ventilation, and the cases set for trial.

These mines were in no sense in any worse condition by reason of defective ventilation, than many others in this region which rely on natural ventilation, but they were the only ones in operation in Athens county at the time complaint was made, Longstreth's having an air-shaft and furnace in course of construction, Brooks's Athens county mine being idle, or nearly so, and Scott's having a ventilating shaft and furnace. The mines of Shawnee and Straitsville which have no artificial means of applying ventilation, will also be complained against as soon as the Athens cases are disposed of, unless the owners agree to provide and maintain the amount of current required by the statute, which they can not do by the unaided forces of nature, no matter if there were a dozen openings to each. Ample time will be given to cause the mines to conform to the statute, but the law must be complied with in its letter and spirit, and operators will have themselves to blame for any litigation that may arise.

Longstreth's Mine was, during the summer, improved by the sinking of an air-shaft and the erection of a five-foot furnace near the entrance of the main entry, and the introduction of a locomotive on the main road to haul the mine cars to the chutes outside. The locomotive runs in about five hundred and fifty yards, to the double parting, where the trains are made up, and makes four trips per hour, bringing fourteen cars each trip. The furnace at the bottom of the air-shaft is a good one, moving about nineteen thousand cubic feet of air per minute. The air is received at two openings on the other side of the hill, and the smoke and gases from the locomotive pass away from the miners.. With the current of air now flowing through this mine, there must be good air in every working place, if it is properly distributed. As the pillars of the mine are withdrawn while the general workings are progressing forward, bad air is liberated from the rocks above the coal, and hence a large current of air is necessary to properly dilute and render harmless this poisonous gas.

The old Straitsville Mine, at present operated by Messrs. Moss, Marshall & Doe, lessees of the mine, is opened on the north-east side of the mining property, the main entry running south on the face of the coal. The manner in which this mine is laid out was fully described in my last annual report, though a clerical error located the main entry as advancing northward instead of southward. During the present year the main hauling road has undergone some marked improvements. A new opening, situate two thousand feet southward from the mouth of the mine, was driven through to the second east butt entry, and the full cars, which had to be hauled up grade on the rise of the strata, are now moved on a level road. In entering the hill with this new entry, an ancient creek bed was cut by the miners. The coal was all cut away except about one foot of the bottom part, and its place filled with loose sand, in which branches of trees were imbedded. The wood was in a good state of preservation, indicating that this erosion was of no remote occurrence.

The Troy Mine of the Union Coal Company, situate at New Straitsville, is provided with one ventilating shaft, at the bottom of which a good ventilating furnace is built. When this furnace is well kept up, twelve thousand to fifteen thousand cubic feet of air per minute can be moved by it. The workings of this mine were laid out in blocks or squares, each block being four hundred feet square. All the entries, except the main heading and the Rock Run heading, were formerly single. Now every entry is made double, and the air-courses, formerly driven from one butt entry to another, are abandoned. The main part of the workings are opened up from off two butt entries, namely, the main entry and the first right entry opened off the Rock Run entry. The roof of this mine is excellent over the greater part of the excavations, rooms thirty feet wide standing firm without a single post.

The dumping apparatus of this mine is one of the best in the State. The loaded cars are dumped by machinery. The engine used in working the slack elevators is also used in emptying the mine cars into the chutes. Upton's coal carriage, a valuable arrangement for handling coal, is in use at this mine. There are now twenty-two of these coal carriages in operation in the State.

A coal-cutting machine, known as the "Lichtner Machine," has been at work off and on in the Central Mine for more than twelve months. The machine cuts a groove five feet deep and two and a half feet wide in the bottom of the coal, and does its work with remarkable speed. Some time is, however, lost on moving and resetting the machine every time a groove two and a half feet wide and five feet deep is finished. By actual practice an undermining five feet deep and one hundred feet wide, equal to holing three thirty-three feet rooms, can be performed per day. Where the machine is at work the miners are paid thirty cents per ton for blasting and loading the coal. As, however, three men are required to operate it, one shoveling away the under-cuttings, another attending or operating the machine, and a third running the compresser and keeping up steam, the great desideratum—a reduction in the cost of mining the coal—is not yet achieved. Upward of one hundred coal-cutting machines have been patented in Great Britain alone, beside several more in the United States; and, except in special cases, the cheapest way yet discovered of digging coal is by muscular power.

The steam cylinder is fourteen inches in diameter, the air cylinder twelve inches; the air-receiver is sixteen feet long and four feet in diameter; the compressed air is delivered through a two-inch gas-pipe; the machine makes about one hundred and fifty revolutions per minute.

The Central Mine has been suffering the consequences of leaving weak pillars; a crush of the workings, which commenced more than a year ago, has not yet been effectually arrested, and has done considerable mischief. This mine is a valuable one, the coal extending, without break, under the greater portion of the lands owned by the Coal Company, but the workings extend to the dip, and the cost of hauling coal and drawing water are increased in consequence. The mine ought to have been opened by leaving strong pillars.

The air in one of the entries was not good during the summer, there being no return air-course, and I found it necessary to ask the mine superintendent to find other places for the workmen employed in that part of the mine until fresh air could be taken forward.

The Plummer Hill Mine usually employs a large force of miners, and relies for ventilation on the natural forces. As there are six or seven openings running through the hills at one point or another, and as no blasting is allowed during working hours, the ventilation is usually kept in a fair state. The time is, however, passing away for trusting to the wind and weather to get air in a mine. As the workings extend from year to year, more gas (black damp) is liberated from the coal and superincumbent rocks, the frictional resistance of the air is increased by the increased distance the air has to travel; the natural forces, no matter how many day levels there may be, will in time fail to renew the circulation and purify the air. One part of this mine was operated during the summer without any return for the air, and a number of workmen were suffering in consequence. On calling the attention of the boss to the necessity of improving this part of the mine, he at once erected doors in front of the rooms to create a return current. This mine now needs an air-shaft and furnace or fan.

The Patterson Mine is the best opened work in the Straitsville district. All the entries are double, and are driven ten feet wide. The rooms are made twenty-eight feet wide, but are started off the entries at ten feet, are advanced eighteen feet, then opened out to full width; a pillar fifteen feet separates one room from another. The butt entries are one hundred and fifty yards apart, rooms working to the north and south on the face of the coal. As soon as the rooms meet in the middle of the square, the pillars are attacked and removed to within thirty feet of the entries, and the roof falls in the excavated area to the surface.

This mine has an air-shaft and also a ventilating furnace, the latter being able to move ten to twelve thousand cubic feet of air per minute. The air is clean and sweet in every working place in the mine, and the miners, one and all, feel proud of the sanitary condition of their working places. There is but one way to get air to sweep through the many ramifications of a mine, so that all the working entries and interior rooms may be equally well aired, and that is by driving double entries.

The mine of the Straitsville and Lancaster Mining Company, which had been lying idle for the past two years, has been leased by Mr. John R. Tucker, and is now working regularly. It was visited shortly after starting up by the present operator, and some directions given looking to the improvement of the air.

The Gore Mine, also idle for some years, is now in operation, the coal being used for the supply of the "Thomas Furnace."

The Great Vein Mine, situated at Old Straitsville, which, for a long time, had been running very slack, has recently changed hands, and is now operated by the Consolidated Coal and Mining Company, of Cincinnati, who have a full force of miners at work. The Gore Mine, and Old Straitsville Mine were not visited during the year.

The Upson Mine of the Union Coal Company, the first of the series at Shawnee on entering that village from the railroad, is in good order. It is well laid out and well aired, having a ventilating shaft and furnace. This mine and the Shawnee Valley Mine are models of good order in their ventilation departments, and none acknowledge this fact more promptly than the miners. Indeed, I have never passed through a properly ventilated mine in the State and heard a word of complaint from a single miner, of bad air; on the contrary, all have made haste to express their satisfaction and gratitude with the sanitary condition of their working places. Only where there is bad air, will miners complain, and they would not be men if they did not complain. Even the mules, by their worn and stiffened appearance, bear witness to the insalubrious condition of some mines. Yet superintendents and owners of mines will traduce their workmen for complaining of bad air, and cry out against the mining law as an unwarranted interference with their business.

The XX Mines of the Newark Coal and Iron Company, consisting o three openings, have proper air-ways, air-shafts, and ventilating furnaces. If the furnaces, two in number, are constantly kept up, there can not arise a complaint of bad air, but they are not kept up as they should be, and are frequently allowed to go out altogether. The mine superintendent says the air is good enough without the fires. I must insist, however, in keeping the flues in operation. We never hear complaint of too much air, as the air is not good enough when the furnaces are out.

The pillars of these mines are attacked and withdrawn with good success, though it is found to be the better practice to work all the rooms of a square out, and attack the inmost pillars first, instead of, as was formerly done, withdrawing them in progressing forward, as each room was finished up. The rooms are twenty-four feet wide, the pillars twenty-one feet thick, and every break which follows the extraction of pillars is successfully resisted. The pillars are withdrawn in echelon, the inmost being first attacked. Fourteen pillars were recovered during the past year, and less than one-seventh of the coal was sold, consisting of small stumps left in cutting through after a fall in the excavated area. In the dip workings it is found necessary to let the pillars stand at present.

The Shawnee Valley Mines are well opened and well ventilated. The main entry, which runs south three degrees west, on the face of the coal, is half a mile long. There are six butt entries, five running west and one east. These cross entries are each one hundred yards apart; the rooms work to the south, being opened up only on one side of the entry. The entries, face and cross, are made ten feet wide, the rooms are twenty-eight to thirty feet wide, the pillars left between rooms are twelve to fifteen feet thick. The main entry is double, but the cross entries are single, though they are divided into two compartments by a brattice partition for air. The air-course is cut out of the lower four feet of coal, and is made three and one-half feet wide

An air-shaft forty-four feet deep, with a wooden stalk twenty-four feet in height, forms the upcast. There is a five-foot furnace at the bottom of this pit, capable of moving twenty-five thousand cubic feet of air per minute.

About three hundred yards south of this mine another mine is opened, called the Fanny Furnace Mine, the main entry of which runs on a line parallel with the main entry of the Shawnee Valley Mine. The butt entries of the Fanny Furnace opening, which extend eastward, cut through on the west entries of the Shawnee Valley. Both mines are ventilated by one upcast, though a current of air is received at each drift-mouth. Each stream ventilates its own mine; both are then united, and flow to the upcast shaft.

The Fanny Furnaces, No. 1 and No. 2, both of which are now in blast, are supplied with coal drawn from the Fanny Furnace Mine. The coal is used in these furnaces in a raw state; Furnace No. 2 was started up with raw coal. This mine is controlled by thirty miners, but the work is done under the supervision of the mine boss of the Shawnee Valley Mine, Mr. Thomas Phillips.

The New York and Straitsville Coal and Iron Company's Mine, opened on the south side of the creek, has only five to six feet of coal, this reduced height being caused by the upper bench of coal splitting in two by a wedge of shale, as described and illustrated in my last annual report. The main entry of this mine runs west on the butts of the coal. It is through the first hill, and a new opening has been made on the second one, five hundred and fifty yards west of the chutes. These entries are single, but a butt entry running parallel with the main entry is double, a pillar of seven yards in thickness, dividing teh parallels. This mine has neither furnace nor air-shaft, and needs both more than any mine at Shawnee, as owing to the reduced height of coal the miners have to blast at all hours of the day. The arrangements for distributing the air are good, but there is not air enough to distribute, because there is not the ventilating power to move the air. I went over the ground with the mine boss and located a shaft, on my last visit to the mine, and called the attention of the general manager to the necessity of having it sunk at once.

The Lyonsdale Mines and the Furnace Mines were not inspected while visiting this region.

The mines of Coshocton were visited in the early part of the year. Only the Home and Miami Mines were inspected, the Beech Hollow being idle, and the other openings of the neighborhood working a less force than ten miners at once. Two mines at Franklin were working, but were not visited, as I intended to make a second visit to this district during the summer; but a strike occurred in August, which lasted two months, and the district was passed over. The Home Bank, which had been thoroughly overhauled, and a new furnace built shortly after the mining law went into operation, was, during last inspection, in none too good order. The Miami Mine had bad air in one part of the workings—black damp—which had become liberated from the goaves of the Beech Hollow Mine. An entry in this part of the bank was approaching day, and the boss proposed to drive it out through the hill as rapidly as possible, as the only practicable means of getting fresh air. The chutes of this mine were destroyed by fire during the strike. The chutes have been rebuilt, and the mine has commenced operations.

MASSILLON.

Pigeon Run Shaft, situate three miles south of Massillon, is the most southerly opening in the lower coal in the Tuscarawas Valley. The pit e hundred and eighty-five feet deep, and is divided into upcast and ı-cast compartments. One hundred yards north of this pit, an air- ; one hundred and seventy feet in depth is sunk, making two up- ı, each having one of Blake's steam-pumps at the bottom. The main y runs on the face of the coal, and extends on both sides of the shaft. se are called the north and south main entries. The butt entries, ch are one hundred and fifty yards apart, extend east and west of the ı entry, and these galleries are called the first east, the second east, first west, and the second west, as the case may be. The ventilation od throughout the mine, and the buildings surrounding the shaft are built with care and safety. There are three steam-boilers, each ty-three inches in diameter by thirty feet in length. The hoisting ne is set back thirty feet from the pit mouth, and the smoke stack is ack six feet from the end of the engine-house. An eight-foot diam- funnel covers this stack at its base, to guard against fire. An air of rity surrounds this mine in the construction of the shaft buildings, ch might be imitated with profit. The fly-wheel of the engine has rake, however, and needs one.

he Warmington Mine is situate on the right bank of the Tuscarawas er, two and a half miles south of Massillon. The hoisting shaft is ıty feet deep, and is divided into upcast and down-cast compart- ıts for ventilation. A steam-pump, located on the bottom of the up- , gives motion to the ventilating columns. A little east of the hoist- shaft the escape shaft is sunk. The main entry of the mine, run- g on the face of the cone, extends north and south on both sides of shaft. The butt entries branch off east and west, and open up the n workings.

he ventilation is in a fair state, though the heat from the exhaust m does not of itself possess the necessary power to give rise to such a mn of wind as is needed for a mine of any extended area, and before ; additional power—the furnace or fan—must be called into requisi- . The workings of the mine are yet of limited extent, the shaft ing been sunk in 1875. All the entries are double, and the air is ied well forward to the working faces of the mine. The rooms are ı nine to ten yards wide—pillars from two to three yards are left be- en them. The butt entries are from one hundred to one hundred and yards apart, according to the conditions for commencing work on butts of the coal.

he Prescott Mine is situate on the eastern bank of the Tuscarawas er, three miles north of Massillon. The mine is a drift opening, the being thirty feet above the bed of the river. This work has been most of the time since the mining law went into operation, and at the time of my last visit, in May, was working only twenty to twenty-five hands. The coal is thin—about three feet—in the swamp, and it loses height rapidly on the hillsides. The swamp is a long, narrow trough, which runs in a general south-east course. As the mine was opened in the northern end of the swamp, the main entry has dipped from the mouth to the face, the dip being nineteen feet in one thousand one hundred yards. The water is discharged by means of a steam-pump placed in the return air-course, the pump being moved forward, from time to time, as the entry advances.

The air comes in at the drift mouth and passes along the main entry for about six hundred yards, where a trap-door placed on the entry throws the current into the Donald entry; thence it passes forward to the faces of the workings, and returns by the main entry to the door already mentioned, whence it is carried to an air-course on the opposite side, and, mixing with the exhaust steam from the pump, returns to a shallow up-cast shaft, and is delivered to day.

Willow Bank No. 3 is a slope opening seventy yards in length, and dipping nine inches to the yard. Where the slope is sunk the strata overlying the coal are soft and fragile, and the slope is timbered the whole way down. For several hundred feet from the bottom of the slope the main entry is also timbered, owing to the brittle cover, but gradually a hard and compact roof is reached, and the mine opens up into a fine coal deposit. The seam is four to four and a half feet in thickness, and is disposed for several hundred yards in a rather narrow swamp, which runs quartering to the right across the face of the coal. The main entry, which is worked on the face, lost the swamp to the right, and one of the rooms in the third east entry in the bottom of the trough was turned into the face entry, and the original gallery abandoned.

This mine is comparatively new, and promises to be a rather extensive one. The roof where the workings now are is a hard and strong shale, and stands well. In laying out the workings. the butt entries are made fifteen feet wide, with pillars four to five yards between the parallels. The rooms are ten yards wide, are broken off the entry six yards wide, and the miners commence to widen after the first shot is fired. The pillars between the rooms are two to three yards in thickness. By this plan of working, the debris of the entries and the new rooms is "gobbed" on the spot where the coal is wrought, and a saving is also had in the lessened cost of driving wide entries. If, however, this mine should widen out into an extended plain, from which coal may be drawn for fifteen or twenty years, the frail pillar supports may give way before the domain holding the coal is half wrought over, and thus swallow up, many times over, the savings of other years. The pillars left between the rooms, in view of the wide butt entries and wider openings, in breaking off the rooms should be at least five yards thick. As most of this pillar coal can be recovered in finishing up the mine, it is always wisdom to leave heavier pillars than are deemed necessary in working forward, to allow for miscalculation or accident.

The ventilation of this mine was good. An air-shaft 100 feet deep, at the bottom of which one of Blake's steam pumps is placed, gives motion to the air. An iron basket is also used, which serves as a temporary furnace. There is a good chance to erect a substantial furnace, and when this is needed it will be built. With the wide galleries of this mine, and the ventilating power aided by the exhaust steam of the pump, a roomy, well-constructed furnace will give motion to 50,000 cubic feet of air per minute.

This coal deposit, which is evidently but an off-shoot or arm of the main basin in which the extensive mines of the Willow Bank Company are opened, is not more than seventy yards wide. The coal rises on both sides of the swamp, and loses height in doing so. Soon a white, hard, fine-grained sandstone is encountered, which forbids further working in that direction.

The Bridgeport Mine, Morgan Owens, owner, is situate on the river bank, between the Prescott Mine and Massillon, and is also a drift opening. The coal is shipped by canal exclusively, and the mine near works a large force of men, usually not less than ten. This mine was discovered forty-eight years ago, and was the first opening in the Massillon region. The coal is quite thin, thinner even than in the Prescott Mine, ranging from two feet to two feet eight inches. In the air-shaft, which is sixty feet deep, there is no trace of Coal No. 2. These facts have led Mr. Owens, the owner of the mine, to believe that the coal is not the lower bed, but Coal No. 2, and he contemplates searching by boring for Coal No. 1. As, however, the coal is within fifteen to twenty feet of the river bed, and is covered in proper place with the "Massillon sandstone," there is hardly a doubt but it is Coal No. 1, Coal No. 2 being absent altogether—no unusual condition in this valley.

The Diamond Mine, situate in Wadsworth township, Medina county, has been a source of trouble ever since the mining law went into operation. It was opened up in some of its most important divisions by single entries. There were leaking air-courses, badly hung doors, and inattention to the requirements of the law generally. The mine owners, I feel assured, desired to have everything done as the law requires, and believed that everything was so done, and blamed the miners for their spirit fault-finding, and felt unfriendly toward the Inspector for insisting on improvement, and for complaining to court because his recommendations were not enforced. As there is now a new underground boss, who seems to be a man of energy and practical experience, it is to be hoped that no further cause of complaint will be necessary. It is anything but agreeable to my feelings to be forever insisting on better air, and of being compelled to apply the remedy of injunction to have the law enforced and obeyed.

The Wadsworth Slope, also situated in Medina county, was visited in November. There were three entries running—the main entry, which is double, with a chain pillar three yards in thickness dividing the parallels, and two butt entries, one of which is also driven double. A horseback three hundred yards in thickness was met and cut through on the main entry of this mine during the year, requiring the expenditure of a great deal of time and money. Inside the horse-back the coal is dipping, which interferes with the work of re-opening the mine. These horsebacks have forced the working men of the mine into rooms and entries near together, and made the ventilation less perfect than it used to be. This mine will require a shaft at the bottom of the dip in the face entry in order to apply a steam pump to discharge the waters of the mine. This shaft can be made to act as the main air-shaft of the mine, and a good furnace and steam pump applied there will give an abundance of wind for all the ramifications of the mine. The butt entries of this mine are 130 yards apart. The rooms, which are 9 yards wide, with two-yard pillars, meet in the middle of the block.

The mines of the Silver Creek Company, three in number, consist of one drift opening and two shafts. The old shaft is nearly wrought out, all work being on the pillars. The new shaft has been recently sunk, and the arrangements for shipping are not yet completed. This shaft has a ventilating fan of the same size and manufacture as that in use at the Pike Run Mine of the Tuscarawas Coal Company. As the mine is new, and there are no air-ways of any extent, the fan has to be run slow, and at times to stop altogether, as it makes too much air, and "freezes" the men below. When, however, the workings are extended so that the air will require to travel through four or five miles of sinuous and contracted air-courses, the full force of the fan will be needed to overcome the frictional resistance which the air will meet.

This fan is run by the hoisting engineer of the shaft, and needs no other attendance, hence the cost of a furnace man, including the coal burned in the furnace, is saved. The ventilating exhaust fan must supplant the furnace altogether. For our shallow mines it is to be preferred to the furnace. Its economy as compared with furnace ventilation is a strong recommendation.

The Akron district, composing the upper mines of the Tuscarawas Valley, were not inspected during the year. I visited Jacobs' and the Franklin Mine twice, but they were idle each time. I directed some changes to be made in the ventilation of the Franklin Mine looking to an improvement in the air. The Pomeroy district and the Ironton district were also not visited, for want of time. It takes a year of constant and energetic work to inspect every coal mine in the State, and with the other duties of the office the round trip can not be made in much less than two years. The hauling roads in the different mines extend over 1,500 miles. Most of this distance has to be traveled on foot. If a mine is properly inspected it requires from eight to ten hours to do the work, and unless the Inspector will go into the mine himself, and traverse all its various ramifications, he can not know whether the law is being complied with or not. To inquire of the boss or the mine superintendent if the air is good serves no purpose whatever. It is to the interest of such officers to say every thing is right, or to be able to show that they are about to commence, or have already commenced, the work of improvement. The presence of the Inspector in the mine inspires the miners with a sense of security; and the fact that miners can call upon such officer in perfect confidence, at any time, to inspect their dangerous subterranean work-shops, gives them an interest in the Government which they could not otherwise feel.

SKETCH OF EARLY MINING.

The coals of north-eastern Ohio, exposed in the ravines and valleys on their line of outcrop, were known to the earliest white inhabitants, and coal was mined by stripping, near the village of Talmadge, in Summit county, as early as 1810. The first mines opened by drifting, in this region, were operated by Messrs. Asaph Whittlesey and Samuel Newton, in the year 1820, the coal being sold exclusively for blacksmithing purposes. In 1828, the first shipments were made to Cleveland, from the mines of Mr. Henry Newberry, father of the eminent geologist, Dr. Newberry, at Talmadge, Summit county, with the object of supplying the lake steamboats with coal; but wood was so abundant and cheap, that the coal could find no sale. In the Mahoning Valley, the late Governor David Tod commenced mining, in a systematic manner, on his farm at Briar Hill, in 1840, and on the completion of the Ohio and Pennsylvani Canal, from Akron to Beaver, began the shipment of coal to Cleve In 1845 coal had wholly supplanted wood on the lake steam

89688

from this time the city of Cleveland has been the chief market for the coals of the Mahoning and Tuscarawas Valley coal regions of the State. In 1840 the aggregate shipments to Cleveland only reached 5,080 tons. In 1850 the shipments reached 83,850 tons; in 1854, the trade had reached a quarter of a million tons.

The first iron manufactured from raw coal, in the United States, was made from the block coal of the Shenango Valley, of Pennsylvania, and the Mahoning Valley, of Ohio. In the year 1845 the Clay Furnace was erected, near the village of Sharon, in Mercer county, Pennsylvania, by Messrs. Himrod & Vincent. The furnace was originally built for the use of charcoal. About three months after it was blown in, the supply of charcoal becoming short, stone coal from an adjacent mine was converted into coke, and mixed with the charcoal in the furnace, with gratifying results. Soon afterward, the cokers struck work, for the redress of some grievance, and the furnace owners, unwilling to accede to the demands of the strikers, ventured to try the use of raw coal. The furnace continued to do well, and to this circumstance is due the first use of raw coal in the blast furnaces of America. At this time, Messrs. Wilkinson, Wilkes & Co. were building a stone coal furnace at Lowell, near Youngstown, in the Mahoning Valley, not to use raw coal, but coke. The furnace blew in in August, 1846, and for some months was run with coke from the block coal of the valley. The coke was then abandoned, and raw coal substituted. Both of the above furnace firms claim the honor of priority of use of stone coal, but the first metal made in this manner was undoubtedly manufactured under the supervision of the late David Himrod, at the Clay Furnace, in the State of Pennsylvania.

Before the year 1850 there was little or no systematic mining in the Leetonia district. Mr. Anthony Whistler operated a mine at Washingtonville for several years before the property on which the mine was opened came into possession of the Cherry Valley Iron Company. Whistler usually employed two or three miners, who dug the coal and pushed it out in small cars to the mine mouth. The slack was converted into coke, and was sold in Salem and Massillon for foundry purposes, the lump coal being sold to blacksmiths. People came from Deerfield, Ellsworth, Canfield, Georgetown, Columbiana, and Damascus to buy the coal of this mine, it being a superior blacksmithing coal. John Chamberlin, one of the founders of the Cherry Valley Iron Company, got possession of this mine in 1858, and he at once opened it out on a more extensive scale. The Cherry Valley Iron Company was soon afterward organized. In 1867 the two blast furnaces of this company were erected; the rolling-mill being built in 1871. The slope mine of this company at Leetonia was opened the same year the blast furnaces were completed.

SKETCHES OF HOCKING VALLEY.

The seams of coal and iron ore of the Hocking Valley, which lie above the river-bed, laid bare on both banks of the Hockhocking and its tributary streams by the action of water, were noted by the first white men who traversed this region. A map of the Western country, now in the possession of Judge P. H. Ewing, of Lancaster, which was published in the year 1788, notes several sections of coal and ore beds; and Harris, in his tour, in 1803, states that on the banks of the Hockhocking "quarries of excellent freestone, beds of pit-coal, iron-ore, lead, strata of white and blue clay, of excellent quality, red bole, and many other useful fossils are found."

The construction of the Hocking Valley branch of the Ohio Canal was commenced by the Lancaster Lateral Canal Company in the year 1832, and that part of the canal known as the "Side-cut" was completed to Lancaster in 1836, the first boat being towed into the village of Lancaster on the 4th of July, amidst the roaring of artillery. In 1838 the State purchased the Lateral Canal from the Lancaster company, in 1839 the canal was completed to Bowner's Lock, sixteen and one-half miles below Lancaster, and in 1840 it was finished to Nelsonville, the first boats loaded with coal coming up the canal from the mines at Nelsonville in September of that year. In 1841 the canal was completed to Athens.

Immediately after the location of the Hocking Valley Canal, eastern capitalists and others of our own State made extensive purchases of lands along the line of the canal from Lick Run to Chauncey. Among the most extensive purchasers were Thomas Ewing and Samuel F. Vinton, who shortly afterwards associated with themselves Nicholas Bidd and Elihu Chauncey, of Philadelphia, under the name of Ewing, Vinton & Co. This firm made an opening for coal about the time of the completion of the canal to Nelsonville. Their mine was located in the hillside, on the Nelsonville seam of coal, at the Door's Run canal basin, on what is now the west end of the incorporated village of Nelsonville. At this point the coal is well up in the hill—probably one hundred and twenty-five feet—and it was reached by an incline plane extending from the canal to the mouth of the mine. Two cars, of seventy-five bushels capacity, were used on the incline. The mine cars held ten bushels, and were pushed by the miners from their working-places to the mine mouth and dumped into the cars at the head of the inclined plane. Only the lower four feet of the coal-bed was wrought, the upper two feet being left for a roof, owing to its being of a somewhat inferior quality to the lower vein. Twenty years after this mine was opened, the top coal, abandoned by the first workers, was recovered and shipped to market. The manager of this mine was Mr. Launcelot Scott, a practical miner, from the North of England, father of John W. Scott, the present owner and operator of the Lick Run Mines. After managing for a short time, Mr. Scott leased the mine and continued to work it and other openings, which he made on the same track, for many years, and he was really the pioneer miner of the Hocking Valley.

The best market for coal at that time was at Newark, Ohio. Up to the year 1842, more coal was consumed in that town than in Columbus. The earliest buyers of coal of any consequence in Columbus were John L. Gill, and the old Neil House. The lowest price ever paid for mining coal, at the mines, was one and one-half cent per bushel, thirty-seven and one-half cents per ton, a price which it has come within three cents per ton of again reaching during the present year. The lowest figure coal sold for never reached sixty-five cents per ton, and during the present year the best screened lump coal has been delivered on board the cars for sixty-five cents.

Shortly after the mine of Biddle, Ewing & Vinton was opened, another opening, by Fuller & Walker, was made, a little further up the river. This mine had also an incline plane. C. Fay, John Crothers, C. Steenrod, J. F. Somers, and L. Steenrod, were also among the pioneer miners of the valley. Their mines were situate on both sides of the Hocking River, at Nelsonville, and the coal was hauled in wagons from the mouth of the mines to the canal, dumped on the wharf, and loaded on the boats with wheelbarrows.

The early settlers of the Hocking Valley procured their supply of salt from the surface springs in the Muskingum Valley, and in Jackson county. The first well in which salt was struck, in paying quantities in the Hocking Valley, was bored in the year 1831, near the mouth of Sandy Creek, in Athens county, by Resolved Fuller, the water yielding ten per cent. of salt. Several holes had previously been sunk in the valley, but the supply of water was too limited, and the yield in salt was only seven per cent. In the year 1836, Messrs. Ewing and Vinton purchased this well, at the same time investing largely in coal and iron ore lands on the line of the Hocking canal. Between 1836 and 1840 three other wells were sunk by Ewing, Vinton & Co., the water also yielding ten per cent. Several other wells were sunk further up Sunday Creek, between the years 1836 and 1840, but owing to the increased expense of transporting the salt to the canal, they were abandoned in 1845. This firm also bored at Nelsonville, and between Nelsonville and Chauncey, but the yield of salt was only seven per cent., and these wells were never operated.

There are at present in operation in the Hocking Valley, four different establishments engaged in the manufacture of salt, namely, the Prudent Salt Works, the Herrold Salt Works, the Salina Salt Works, and the Chauncey Salt Works. The Pruden Works are situated three miles below Athens, and turn out 7,000 barrels of salt per annum; the Herrold Works, located one mile above Athens, and owned by Joseph Herrold, turn out about 1,200 barrels per annum; the Salina Works, located at the village of Salina, five miles above Athens and Chauncey, owned by G. T. Gould, have a capacity of turning out from 15,000 to 20,000 barrels per annum, and the Chauncey Works, the original Ewing, Vinton & Company Salt Works, now operated by Hocking Valley Coal and Salt Company, make about 12,000 barrels per annum, though their capacity is nearly double this amount.

The salt water in the wells at Chauncey and Salina, is struck at a depth of about 560 feet below the bed of the Hocking River; at Athens it is considerably deeper. The average strength of the water in the wells of the valley is ten per cent. The water is met in a bed of sandstone, at the base of the coal measures which averages seventy to eighty feet in thickness. This sandstone is the equivalent of the Logan sandstone of the Geological reports. At Salina and Chauncey, the Bayley's Run coal is level with the bed of the Hocking River, and the Nelsonville seam, 100 feet below the Bayley's Run bed, is passed through in every well. The Nelsonville coal has been opened by shafting, at both Salina and Chauncey, and the coal from the shafts is used for firing the boilers of the steam engine of the salt works. At Athens the Bayley's Run coal is nearly 100 feet, and the Nelsonville seam about 200 feet below the bed of the Hocking River.

THE OHIO RIVER.

The Ohio River is the greatest coal carrier in the world, and its vast trade is the development of little more than forty years. No where else is found such cheap and rapid transportation for bulky freight. The cost of shipping coal from Pittsburgh to Louisville, a distance of 600 miles, being only one and three-quarters cents per bushel, equal to forty-seven cents per ton, and this includes the return of the empty barges. The cost of shipping from Louisville to New Orleans, also, is but two cents per bushels, or fifty-five cents per ton, the distance being 1,400 miles. The time required to move coal from Pittsburgh to Louisville, with a good river, is only five days, while shipments are made from Louisville to New Orleans in ten days. The lowest freights charged by railroads is one cent per ton per mile, while one and three-quarters and two cents per ton per mile are frequently charged.

The first systematic efforts at coal mining on the Ohio River, below Wheeling, was inaugurated by Samuel Wyllys Pomeroy, of Boston, Massachusetts, in the year 1833. Mr. Pomeroy purchased the lands on what the mines of Pomeroy are now opened in 1803. In 1818, he wrote a merchant in Cincinnati, to ascertain the consumption of coal between his coal property at Pomeroy, and the falls of the Ohio, with the subject of opening the mines, and the reply was as follows:

"I am able to communicate to you the following information:

	Bushels.
Cincinnati Steam Mill consumes, annually	12,000
" Iron Foundry consumes, annually	20,000
" Manufacturing Company consumes, annually	5,000
" Steam Saw Mill consumes, annually	5,000
" Sugar Manufacturing Company consumes, annually	2,000
	44,000
In Maysville, used or sold	30,000
In Louisville, used or sold	30,000
Madison Steam Mill, 100 miles below Cincinnati	12,000
Total	116,000

The following were the receipts for the years 1875 and 1876:

	Bushels.	
	1875–76.	1874–75.
Youghiogheny	27,017,592	24,225,002
Ohio River	4,400,792	4,277,327
Kanawha	6,004,675	4,476,619
Muskingum Valley	177,730	312,000
Hocking Valley	1,350,000	636,000
Cannel	409,358	565,352
Anthracite	282,578	248,750
*Other receipts	540,592	649,250
Totals	40,183,317	35,390,300

*Principally Hocking and Muskingum Valleys and Washington coal not elsewhere embraced.

The Pomeroy coal did not enter into domestic use in the towns of the Ohio River till the year 1833. The cost and scarcity of boats to transport the coal down the river induced the proprietors of the Pomeroy mines to build a steam tow-boat to tow the loaded barges from the mines to Cincinnati, and bring the empty barges back. This boat was named the Condor; she took her first tow to Cincinnati in 1836, and was the first tow-boat on the Ohio River.

The scheme of towing coal, an article of so little value and such great bulk, a distance of two hundred and twenty-five miles, was ridiculed by the steamboat owners of that time as a visionary enterprise. But the experiment proved a success, and in a few years afterward another tug, the Lake Erie, was built at Pittsburgh.

In 1834 the use of coal for domestic purposes in the towns of the Ohio River was almost unknown. To encourage its use the mine operators of Pomeroy advertised publicly that they would adhere to a specific price to families, namely, twelve and a half cents per bushel. The safety and convenience of coal, as compared with wood, brought the Pomeroy coal into use, and it soon achieved a high reputation as a household fuel. Thirty years ago the steamboats plying the Ohio used wood exclusively for fuel. The Pomeroy Coal Company made persistent efforts to substitute coal for wood, and were finally successful.

NOTES RELATING TO THE PRODUCTION OF SALT AT POMEROY, AND VICINITY, MEIGS COUNTY, OHIO.

BY S. W. POMEROY.

The salt-yielding territory on the Ohio River, extends from Letart township to the lower limit of Salisbury township, all in Meigs county.

The opposite shore of the river, in West Virginia, has, relatively, the same limits.

The volume of salt-water reaches its maximum at and near the great bend of the Ohio, at which Pomeroy is situated, decreasing above and below.

Two furnaces below—one at Middleport, and one below Leading Creek—have been abandoned for want of sufficient brine.

Eleven furnaces are in operation, in the following order, viz.:

Name.	Location.	Wells.	Monthly product.
			Bushels.
Riverside	Letart township	6	15,000
Syracuse	Syracuse	5	26,000
Sutton	Sutton township	4	30,000
Windsor	Minersville	5	35,000
St. Louis	"	4	30,000
Coal Ridge	Pomeroy	4	30,000
Buckeye	"	4	33,000
Excelsior	"	4	30,000
Sugar Run	"	3	20,000
Pomeroy	"	3	25,000
Dabney	"	6	35,000

The salt is shipped in barrels, by steamers, above and below, but mainly transported, in barrels or in bulk, in barges, towed by tugs, to ports on the Ohio, Cumberland, and Mississippi. Common, dairy, and table salt are made. The best constructed furnaces consume about a bushel of coal for a bushel of salt made. The following analysis, by Prof. J. L. Smith, and Dr. T. E. Jenkins, of Louisville, is the result of several examinations, viz.:

	Ohio.	Kanawha.
"Moisture, by heating to 220° Fah	2½	3
Chloride of calcium	½	⅛
Pure salt	97	96⅞

"The two salts are so analagous in their composition, that there is no practical difference in them. We would state, as the result of our examination, that there is no better salt brought to this market, for packing meat, and for other uses to which salt is applied, than the Ohio River salt."

Bromine.—Large quantities of bromine are distilled from bittern, or bitter-water, the residuum of the brine after the pure salt is extracted, and used in this country, or exported to Europe, for the preparation of bromides, the use of photographers, and for the analine dyers. The bittern, now a source of considerable revenue to the salt companies, was but recently drained from the furnaces to the river. Its curative properties are yet but imperfectly known. As affecting gout and rheumatism, it is proven to be at least equal to the waters of St. Catherine's, Canada, having all the constituents of that celebrated water, with the addition of bromine and a trace of iodine.

Salt was made in the early settlement of Ohio, near the Scioto, Muskingum, etc., from salt springs, and, later, in this county, from shallow wells. The first deep wells were bored in Pomeroy, and the first salt made at the Pomeroy furnace, in 1851. The depth of wells increases with the ascent of the river, from 1,000 to 1,500 feet, somewhat coincident to the dip of the coal strata. In 1851, a copious flow of coal-oil was found, in boring for salt, at Coalport—sometimes equal to twenty barrels per diem. This was previous to the discovery of the means of refining it; and that saved was mainly used in the preparation of the liniment known as the "Mexican Mustang."

GENERAL REMARKS ON MINING.

There are two general methods or systems of laying out the workings of a mine, known as "long-wall work" and "pillar and room work." These systems are divided up into numerous plans according to the varying circumstances and conditions existing in the various coal regions and the different beds of coal in the same region. In Ohio we have no work carried on by long-wall mining, and only in two instances has any attempt been made in the State to work a mine on the long-wall plan, and both attempts were speedily abandoned. There is but one coal district in the Union where long-wall mining is in general use—the Braidwood district in the Wilmington coal region of Illinois. A description of this district and plan of mining is given in another part of this report from the pen of John James, Esq., one of the most intelligent, practical miners in the United States.

The advantages of long-wall working consist in removing all the coal as the workings progress forward, allowing the overlying strata to fall down behind the miners. This method is in general favor in Belgium, in South Wales, and in many parts of England and Scotland, wherever the conditions are favorable to its prosecution. Seams of coal with a firm roof of shale and a compact floor are best suited for long-wall work. The roof must, however, be comparatively free from water, and no valuable buildings or water streams ought to overlie in underground excavations.

Beds of coal which have bands of shale, fire-clay, or impure coal running through the body of the coal or immediately overlying the top of the seam are generally sought to be won by long-wall mining, if other conditions are favorable, because such refuse material serves for stowing back in the gob and for building pack walls along the sides of the hauling roads of the mine. There are various methods of laying out a mine by the long-wall system, according to the varying conditions—the height of the seam, the amount of natural stowage, the nature of the roof and floor, the depth of seam below the surface, etc. As in pillar and room working, the best results are not always attained by the plan followed. In long-wall mining the ventilating current of air is always kept playing at the wall fans, and the air is pure and sweet in consequence, while in working mines, by pillar and room practice, the various galleries are driven forward ahead of the moving column of air. This is called ing in the fast, and is made necessary in the formation of the coal pillars left for the support of the superincumbent strata. When too great an advance is made in the fast, the air becomes stagnant, and unfit for the abode of the miner. If powder is used in blasting out the coal, the smoke from the explosion hangs for hours in the room or entry, and is often so thick after a shot has been fired that the miner can not see to work for half an hour or more. The distance which a room or entry may be advanced in the fast varies in different mines, according to the number of men employed, the amount of powder used, the gases generated in the mine by nature, and the vigor with which the current of air is flowing along the air-ways and break-throughs, etc. Some places are advanced two hundred and even three hundred feet, but one hundred feet is far enough, if the health and vigor of the workmen are valued.

In working by pillar and room, there are four general plans followed: 1st. Working with pillars of just sufficient strength to support the superimposed strata while the workings are progressing forward, and leaving all the pillar coal behind in the mine. 2d. Working with pillars of extra size, with the object of attacking and removing the pillars after the workings have been pushed to the boundary of the mining property. 3d. Working in panels or squares, with the object of attacking and removing the pillars after a panel has been worked out, during the general forward progress of the excavations. 4th. Driving the entries or galleries to the boundary of the mining property before any rooms are opened, then beginning at the boundary with the rooms and working backward to the bottom of the shaft or the mouth of the drift.

The last of these methods is the best, having in view the recovery of the greatest yield of coal per acre, the general security of the mine, and systematic perfection in ventilation; but the increased outlay of money and time before any returns are made, occasioned from driving forward to the interior lines of the mining property, militates against its general application. When money is invested in mining, especially where stock companies are the investers, the pressing demand is for immediate returns on the capital invested, rather than on ultimate advantages. In Ohio there is but one mine operated on this plan—that of S. W. Andreas & Co., at Urichsville, in Tuscarawas county, a description of which is given in the account of the mining operations of that county.

The third system, or a modification of it, is practiced in several of the mines in the Hocking Valley; also, at Pomeroy and some other points in the State. In the Hocking Valley, where single-entry practice prevails, the pillars left between the rooms, as well as the coal left for the support of the entry, are often too weak, and, in the general crush that follows, there is danger of the entry being overrun and closed. To guard against this danger, the plan of opening rooms has recently been changed by opening each alternate room only off the entry, and leaving strong rectangular pillars seventy to eighty feet long, and thirty feet thick, to resist and break the crush as the pillars are robbed down towards the foot of the panel. In the Pomeroy region, where all the entries are double, the pillars are successfully drawn without danger to the galleries of the mine.

The second system of laying out workings is the one in very general use in this State. The object is to advance the work to the boundary of the mine, and then attack the pillars, working backward toward the pit bottom. A very common mistake is made by managers, which time and experience seems only to be able to correct, in leaving too small pillars. Not a year passes that does not witness the falling in of some valuable part of a mine, caused by a crush overrunning the pillars. In mines such as those of the Mahoning Valley, where the coal basin is narrow, the shaft shallow, the roof hard and firm, the seam of coal a compact splint, and the floor a strong shale, very light pillars suffice to maintain the workings until the domain holding the coal has been wrought over. Where, however, the overlying strata are several hundred feet thick, and the coal floor a soft and yielding fire-clay, unless large pillars are left, the mine must, sooner or later, give way. There is a strong temptation to leave light pillars, because, in laying out the workings, the coal can be mined cheaper; but these results are swallowed up four-fold when a crush or creep comes on the mine.

The first system of working, namely, taking out all the coal sought to be won in working forward, is the oldest and the rudest method of coal mining. Fifty years ago it was the common practice in England and Scotland, and is followed to a considerable extent in many mining districts of the United States at the present day, but it is disappearing before more approved methods. Some of the mines of the Ohio river, in the Bellaire district, are still worked on this system. Pillar coal is willingly sacrificed, if the price of mining, for the time being, is thereby reduced.

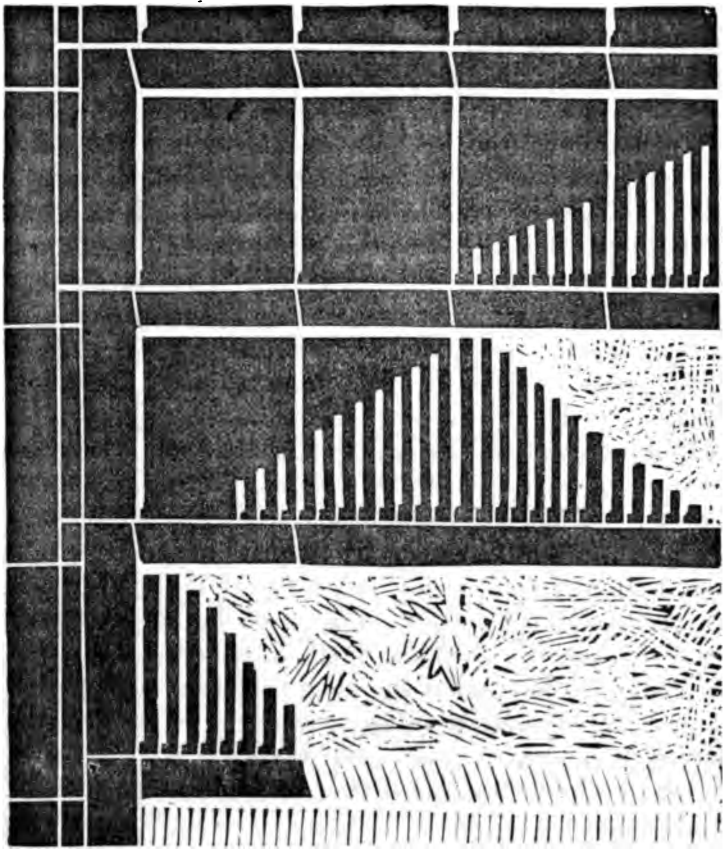
Taking the whole amount of coal mined in the State—about fifty millions of tons—there has been sacrificed, by unskillful modes of mining, fully fifty millons of tons more; at the present time there is fully 33 per cent. lost.

There is no excuse for sacrificing more than 10 to 20 per cent.; but it is to little purpose to lament, or to point out methods of improving, prevailing plans. Coal lands are abundant and cheap, and immediate gains, rather than ultimate consequences, are what every operator seems to study.

In the Cumberland coal region of Maryland, where the mining superintendents are among the most intelligent of their class in the Union, the system of mining has been greatly improved of recent years. The coal of this region is soft and friable, the seam is high, the roof fragile and treacherous—conditions which require skill and care in mining coal successfully. The pillars not only require to be made unusually heavy, considering the thickness of the superimposed rocks, but the chambers of the mine have to be made unusually narrow, owing to the fragile roof. In the earlier days of mining, the practice was to drive the workings to the boundary of the property, and then attack the pillars. Frequently the mine would crush before the workings were driven half way forward, and in working home a valuable per cent. of the pillar coal was lost. In the old Maryland Mine, opened at the village of Echart, a crush occurred in the year 1848. The miners heard and saw the grinding of the pillar coal for weeks, and dreaded final ruin; but the boss encouraged them to work on, declaring there was no danger. One morning, after the whole force of the mine had started work, the mine began to settle down, and such was the suddenness of the crush, that the miners had barely time to escape, leaving their tools, dinner-buckets, and coats behind.

The mines of the Consolidation Coal Company, James Thomas, general superintendent, are now worked in such a manner that a crush of the overlying strata is impossible. The entries are all double, and are laid out in the ordinary method, but the rooms are reduced to thirteen feet of width, and the pillars enlarged to one hundred feet in thickness. The rooms are divided into sections of seven to each panel, and are worked forward to their point of destination, four hundred feet. A cross room, also thirteen feet wide, is driven on the butts of the coal, after the rooms are advanced two hundred feet, for the purpose of supplying air. When the seven rooms are finished up, a series of side rooms are opened in the butts, piercing the pillars, and dividing them into blocks, twenty by one hundred feet. As soon as the flank rooms are finished, the pillars are attacked and withdrawn. The first room has no pillars to remove, and the third room attacks the pillars of the second, and removes them under cover of itself. When the pillars of the second room are out, the fourth room attacks the pillars of the third one, and so on till all the pillars are removed. The roof falls down behind in the area wrought over, and the crushes of the strata are confined to the goaves of the mine. Work on the pillars cease when they are brought down within one hundred feet of the entry. As the rooms in each lift or square are stopped after they reach within forty feet of the air-gallery of the lift above, and as the work of robbing the pillars stops when the pillars are brought back within one hundred feet of the entry, there is a column of coal forty feet thick on one side of the air-entry, and another column one hundred feet thick on the opposite side of the hauling entry, beside the forty foot pillar left between the air and hauling entries. This coal is left for the purpose of resisting and breaking the crushes, which follow the extraction of the pillar coal between the panels or squares of work, as the mine workings progress forward. When the boundary of the mine is reached, this coal is brought back, and most of it recovered.

The mines of the George's Creek Coal and Iron Company, as also some other mines operated on George's Creek, are laid out in a series of panels five hundred feet in length by two hundred and eighty feet in breadth, and the galleries are driven to the boundary of the mining property before the coal is won. In the George's Creek Coal and Iron Company's Mine, of which John Douglas is superintendent, and his son, Captain John Douglas, inside foreman, the main entry, driven on the face of the coal,



PLAN OF WORKING.

is double the first or lower cross entries, being also double—the other cross entries being connected with cross-cuts two hundred and eighty feet long, running parallel with the cross heading, and forming main pillars one hundred feet thick. Between the main entry and the first room of each cross entry a pillar one hundred feet thick is also left. This room is driven up through on the cross entry above, and every eighth room is cut through from one cross entry to the other, leaving seven rooms to each panel. These panels are left solid until the entries reach the boundary of the mining property, where the seven rooms of the interior panel are broken oft. The interior room is started first, and when it is up twenty feet, the next one outside is broken off, and so on, each room of the panel following the other in echelon. These rooms are each advanced four hundred feet to the long cross-cut or main pillar, one hundred feet below the cross entry above. The interior room, in going through on this cross-cut, is "wrought out," and the pillar coal on the inside of the room is attacked. The same practice follows with the other rooms of the panel, the pillars being brought back in echelon. As the pillars of a panel are attacked, rooms are opened in a new panel outside, the workings of the mine going on with something like mathematical exactitude. A dozen or more cross headings on each side of the main gallery may have the rooms of a panel advancing and the pillars of another panel retrogressing at the same time, according to the output of the mine. This is the best system for winning coal by pillar and room working ever practiced, though the system of ventilation, consisting of driving headings and rooms four hundred to five hundred feet in the fast, can not be commended.

The people employed in mining coal in Ohio, from hewing out the coal at the wall faces of the mine to the dumping it in the hoppers at the coal chutes, consist of diggers, drivers, road men blasting roof, and road men laying track, etc., bailers or pumpers, trappers, and furnace tender working inside, and dumpers, loaders, or trimmers, and weighmaster, working outside. The proportion of day men to diggers varies according to the thickness of the seam, the nature of the roof, and other conditions, but usually the height of seam has most to do in this regard. In the Mahoning Valley, where the roof requires to be blasted in nearly every working place, and where the workings are wet and often locally dip on the line of rise, requiring the cutting of costly drains, the working of extra shafts, and the application of hand and steam pumps, sometimes as many as fifty day men will be employed to every one hundred or one hundred and twenty-five diggers, while in the

Hocking Valley region, where the coal is level free, and the seam is so high that a man on horseback may ride in the mine, not more than one or two day men are needed.

In some thin seams only the hauling galleries are blasted, the rooms being worked forward the height of the coal, pushers or haulers pushing the empty cars from the horse roads to the room faces and bringing out the full cars in return.

Except for the additional expense of blasting roof or pushing cars, however, thick seams do not, as a general rule, offer any proportionate advantages for cheap digging over thin ones, because the thick beds generally contain some marked impurity, such as bands of bone coal, bands of slate or fire-clay, or the seam is not equally pure throughout, part has to be left unwrought or thrown in the gob, which militates greatly against the producing power of the miner. In the mines of Hammondsville, Washingtonville, and Leetonia, where the height of bed seldom reaches thirty-two inches, and is often less than thirty inches, the miners dig and load the coal for sixty-three cents per ton, while in the Straitsville and Shawnee mines fifty cents are charged. At Washingtonville and Leetonia, however, every thing that comes from the miner's pick is thrown into the mine car and credited to the miner, but at Straitsville and Shawnee, in adition to the bone coal and two bands of slate that have to be sorted out and thrown back in the gob, the slack and nut coal are deducted off the miner, so that while he is cutting down a nine and ten foot seam of coal he is paid for not more than five to six feet.

The miner prefers to work in a bed four feet high to any other height. Thick coals are generally dangerous seams. A small fragment falling from a ceiling nine or ten feet high produces a dangerous if not fatal wound. In a four-foot coal the ear and eye of the workman are constantly near the roof, and his work, almost always done in a stooping posture, can be performed as well in four feet of height as in ten feet of height. In excavating a mass of coal it is also much safer to stand before a thin seam than a thick one. Of course a good deal depends upon the nature of the coal and roof, as to the amount of danger incurred in mining; a firm coal and a strong roof in a high bed may make the mine safer than in a low coal having a treacherous roof and wall face. In thin seams, also, those of two and a half feet or less, the miners are nearly always subject to rheumatism and lumbago, for while resting they are obliged to stretch themselves full length upon the damp floor of the mine.

The miner's tools consist of a set of picks, from three to six in number, three or four wedges, a sledge, and shovel. Where powder is used blasting out the coal, a drill, scraper, and needle are needed in addition. The pick weighs from two and a half to three and a half pounds, and is, or should be, the main weapon of a miner. The coal is undermined across the room face, generally in the bottom of the seam, for two, three, four, and sometimes five and six feet. About forty blows of the pick are delivered per minute. The first foot or eighteen inches are excavated as the miner sits upon the floor and swings the pick over the leg; he then lies down upon his side, his shoulder resting upon his thigh. If the undermining has to be made four or five feet deep, the front of the groove is made fifteen to eighteen inches high, so as to allow the shoulders to get under the "bearing in." A great part of the coal chippings are too fine for use, and they are either thrown back in the gob or screened outside and dumped at the mine mouth. As the lower part of the seam is generally the best part, a valuable percentage of the coal is thus wasted in preparing a "blast" or "cut." Only in the Mahoning Valley block coal mines, and at Washington and Leetonia, are wedges used in throwing down coal. Of late years more reliance is placed upon powder by the diggers than upon either the pick or the wedge; the coal is blasted before being properly prepared for the powder. Many miners do not mine but butcher their coal.

The price paid for digging does not vary greatly in the different districts of the State. At present they range from forty to sixty-three cents per ton. In the Mahoning Valley the standard price is fifty cents; in the Massillon Valley sixty cents; in the Hocking Valley fifty cents; at Pomeroy two cents per bushel. From three to four tons is a fair day's work in any of the above named districts, taking one month with another. Where fifty to sixty cents a ton is paid for digging, inside day men get $1.62 per day, which is regarded as equal to what the coal-hewer can make, and is more than is made by hewing on an average. When inside day men get $1.62, outside day men get $1.12 per day. The drivers usually get a medium between the inside and outside day men.

The wages of miners have fallen greatly in the past four years. In 1873, in the Mahoning Valley, the price of digging was from eighty-five cents to one dollar per ton; in 1874, from sixty-five to ninety cents; in 1875, from sixty to seventy-five cents; in 1876, from fifty-five to sixty-five cents; and in 1877, from fifty to sixty cents. In 1873, inside men received $2.75 per day; now, they are paid $1.62 per day. The other districts of the State have been reduced in proportion.

The following statement shows the wages paid to miners in the anthracite region of Pennsylvania, for the years named:

Occupation.	January. 1875.	September. 1876.	March. 1877.
Driver	$1 26	$1 13	$0 96
Driver boys	90	90	77
Miners, per car	86	77½	66
" "	1 06	95½	81
" "	75	67½	57½
Headings, per yard	2 02	1 82	1 55
Airways	1 55	1 40	1 19
Gangways	1 35	1 21	1 03
Miners, per day	1 94	1 75	1 49
Inside laborers	1 60	1 44	1 22
Foreman, per month	112 50	100 00	90 00
Roadman, per day	2 20	1 98	1 68
Footman	1 60	1 44	1 22
Furnacemen	1 80	1 62	1 38
Engineer, inside	2 18	1 96	1 85
Night engineer, inside	2 27	2 00	1 85

In the anthracite mines, there are two classes of inside laborers. One class are skilled miners, and are paid the equivalent of what the coal-diggers make. They are called, in the above table, "Miners, per day." The other class are unskilled laborers, and are paid less than skilled miners, though more than ordinary outside laborers. In the anthracite mines, as in Ohio, the miners have to pay for powder, oil, tool-repairing, house-rent, fuel, etc., out of the wages made in the mines.

As compared with the wages of miners in Ohio and Pennsylvania, the following statement is submitted in regard to miners' wages in Great Britain, showing the advances and reductions from October, 1871, to June 18, 1877:

WAGES ON OCTOBER 1, 1871.

East Scotland.—Eight-hour shifts, 5 shillings per shift.

West Yorkshire.—Seven-hour shifts, high coal, 5s. 4d. to 7s. 3d.; low coal, 4s. 10d. to 5s. 3d. No houses. Miners' coal, at getting price to half selling price.

North Wales.—Eight-hour shifts; wages, per shift, 5s. 8d. No cottages found; coal a half selling price.

South Wales.—Eight-hour shifts, 6s. per shift. No cottages; coal, 4s. to 7s. per ton.

Lancashire.—Eight-hour shifts; wages, per shift, 5s. 6d. Find their own houses, and pay market price for coal.

Somerset.—Seven-hour shifts; wages, 3s. 4d. to 4s. per shift. No cottages furnished; coal, powder, candles, etc., free.

Durham.—Five and three-quarter hours per shift; wages, 4s. 8d. Houses, free; coal, 6d. per day.

South Yorkshire.—Eight-hour shifts; wages, 5s. 6–7d. No houses; no coal.

Cumberland.—Wages, 5s. 4d.; neither houses nor coal allowed.

Northumberland.—Five and three-quarter hours per shift. Steam coal, 6s. 1d.; soft coal, 5s. 6d., *net.* Houses, free; coal, 6d. per pay.

Dean Forest.—Eight-hour shifts; wages, 5s. 3d. No houses found; coal, 7s. 6d per ton.

North Staffordshire.—Eight-hour shifts; wages, 5s. ½d. Neither houses nor coal.

South Staffordshire.—Eight-hour shifts; wages, thin coal, 4s. 6d.; thick coal, 6s.

South Wales adopted the sliding scale in January of this year, and South Staffordshire, in July, 1874.

The following shows the percentage at present, received above 1871, and also the greatest advance ever paid:

District.	Above.	Below.	Greatest advance.
East of Scotland			85.25
West Yorkshire	11.43		79.80
North Wales	1.26		47.07
South Wales		1.29	49.73
Lancashire	7.32		65.00
Somerset	10.00		60.00
Durham			58.70
South Yorkshire	5.00		57.50
Cumberland	6.00		54.00
Northumberland		0.44–1.88	50.00
Dean Forest			40.00
West Staffordshire		2.50	46.00
South Staffordshire	19.00		50.00

The following statement shows the price of coal delivered to consumers in London, when the first advance was made, and the present charge:

	Advance.	Price then.	Price now.
West Yorkshire, October, 1871	11 p. c.	26s.	25s.
South Yorkshire, December, 1871	10 "	29s.	25s.
Lancashire, October, 1871	10 "	26s.	25s.
Cumberland, December, 1871	5 "	29s.	25s.
Northumberland, February, 1872	10 "	29s.	25s.
Durham, February, 1872	20 "	29s.	25s.

From the above statement, it will be seen that, considering the reduction in price of coal, the miners are better paid than they were in 1871, and that the profits of colliery owners must be considerably less, even leaving out of question the increased cost of working collieries, owing to the Mines Regulation Act, which came into operation in 1873.

TEMPERATURE OF MINES.

The natural temperature of the coal mines of the State ranges from fifty to fifty-four degrees of Fahrenheit's scale. In some working places, particularly in the narrower galleries, ahead of the circulating current of air, the thermometer frequently rises to sixty and sixty-five degrees, but this unusual temperature is caused by the heat of the workmen's bodies and lamps. Where iron pyrites are undergoing decomposition in the gob wastes of a mine, an unnatural temperature is also met.

At fifty feet of depth below the surface of the earth the thermometer stands at fifty degrees, and there is an increase of one degree for every fifty-five to sixty feet of descent. As the coal strata of the State nowhere exceed a thickness of 1,400 to 1,500 feet, no impediment to working from increase of temperature can ever be apprehended in this State. In British coal mines, however, this is a question of grave concern to mining engineers. In the Dunkinfield Pit the temperature is seventy-five degrees, the depth of shaft being 2,150 feet, and in the Rosebridge Pit, the deepest shaft in England, it being 2,576 feet deep, the temperature is ninety-two degrees. The temperature of the earth would be about 212 degrees, at the ordinary rate of increase, at 10,000 feet of depth, this being the boiling-point of water, and at fifty miles in depth the heat would equal 4,600 degrees—sufficient to melt any known metal.

THE BRAIDWOOD COAL FIELD SYSTEM OF MINING.

BY JOHN JAMES.

In furnishing a description of the system of operating the coal mines of this field, it may not be considered inappropriate to preface it with a brief sketch of the coal itself, the extent of the field, the nature of the coal, and the growth of the coal trade at this point.

This is the nearest point to Chicago where the great Illinois coal field has been tapped, and indeed so far no coal has yet been found closer to that city, and none is thought to exist. For this reason, if no other, an importance attaches to this region that it would not have, if coal was known to have an existence north and north-east of us.

Braidwood is located on the Chicago and Alton Railroad, sixty miles distant from Chicago, and five miles south of Wilmington. The coal produced is called Wilmington coal, and the field is called the Wilmington coal field, because when the coal was discovered here, Wilmington was the nearest town to it, though not one ton of coal has ever been raised in that town, and none is there. Braidwood has a population of 6,000 inhabitants, that have all come in within the last twelve years, and are chiefly dependent upon the mining industry for their living. In 1865 coal had only been found, and the lands were selling at $15 per acre. In 1866 the Chicago and Wilmington Coal Company, now the Chicago, Wilmington and Vermillion Coal Company, bought in and paid for a section of the land at $120 per acre. The beginning of 1867 found this company, which has always been, and now is, the largest corporation operating here, commencing active operations, and preparing for an extensive trade. Then there was no town, but a few rough shanties scattered here and there. This company built its own branch railroad from the main line, furnished its own "flats" for the transportation of its coal to market, and as early as 1868 had invested $475,000 in the business.

This company made extraordinary profits, that soon made evident the excellence of their investment, and did not escape the observation of other men of capital, for in 1870 the "Diamond Coal Mining and Manufacturing Company" was organized and commenced operations, after having purchased quite a tract of coal land. This company was followed by the "Eureka Coal Company," with a large capital, and to it was added the "Wilmington Star Coal Company," and soon thereafter the "Braidwood Coal Company" was given to the number. So we have now five important coal companies, besides a number of small private concerns. The capital actually employed in this field by each of the five corporations, as given by our county coal mine inspector, Hon. William Mooney, in his report of 1876, is as follows:

Chicago, Wilmington and Vermillion Coal Company	$526,000
Eureka Coal Company	291,000
Wilmington Star Coal Company	25,000
Diamond Coal Mining and Manufacturing Company	50,000
Braidwood Coal Company	30,000
Total	$922,000

In and around the mines of those companies, in 1876, there were employed men and boys to the number of 1,665, and produced for the year 510,533 tons of coal. This amount of coal was taken out of nine openings or shafts. We have no "banks" or "drift" openings in this vicinity.

The shafts are all of the oblong character, and run about fifteen feet long by five and a half feet wide. The depth to the top of the coal averages, in the mines presently operated, from 80 to 115 feet. When speaking of the thickness of the seam, for we have but one seam, we always talk of it as a three-foot vein. In fact, however, it is a little thicker, averaging all of three feet three inches in thickness. It is overlaid by a heavy bed of clay shale or soapstone that varies in thickness very much at different points, giving way in some places to floating deposits of sandstone, and in others to pockets of sand and water, or "running sand," as we call it. It is not uncommon to have the sandstone lying directly on top of the coal, and forming the roof of the workings. At the mine of the Braidwood Coal Company, now working, sandstone forms in some parts the roof, and the clay shale in others. Here we have the clay shale taking on between the coal and the sandstone, feather-edge fashion. As we go one way the shale thickens and comprises the roof entirely; as we proceed in the other directions we have it thinning out till none of it exists, and the rock alone is the strata overhead of the mine. At most of the other shafts quite a heavy bed of shale composes the ceiling of the workings, and it makes more than usually a safe one, few serious accidents from falls of roof, comparatively, occurring.

The extent of the vein is much greater than some men have estimated, and dips as we go south and south-west. At a distance of one mile and a half east of our railroad depot, it is found at a depth of thirty feet, but has no roof other than clay. A short distance beyond that it disappears altogether. The Braceville Shafts, located three and one-half miles south-west of us, are about the same depth as at this point, but at Gardner, on the same line, nine miles distant, the coal is one hundred and sixty feet below the surface. At Dwight, eighteen miles further down the same line of road, we find a drill hole put down five hundred feet, and no coal found. This fact has made some think no coal is there, but this is an erroneous opinion, as we have the same vein reached by a shaft at Pontiac, nineteen miles below that point, at over three hundred feet in depth. It is opened again at Bloomington, a distance of sixty-four miles from here, at a depth of four hundred feet, and forms the second vein at that place; so, also, at Fairbury, Livingston county, where it forms the second vein; the same thing at La Salle, La Salle county; Pekin, Tazewell county; Peoria, Peoria county; Springfield, Mc-Lean county; Minonk, Woodford county—at each of those places having a thicker but much rougher and inferior quality of a coal bed above this seam. From the evidence we have, though not demonstrated beyond a doubt, the writer has not the least hesitancy in stating this is but the north-eastern boundary of the most extensive coal bed in the State.

At this point I might say only one system is now employed in taking out the coal—the "long wall" plan of mining. When the first mines were opened, the "room and pillar," or "stoop and room" plan was adopted. So long as local trade had alone to be supplied, with very small shipments outside, the system was all that could be wanted, and, for that matter, was perhaps the best. Our outlying small shafts, that depend on the farming trade during the fall and winter for their means of existence, adhere to it still. But when large shipments were called for—the vein being so low and the floor soft, which is a deep bed of fire-clay, and is an excellent flux in the manufacture of iron—it was soon discovered the room and pillar method was altogether inefficent, and must give place to another. An energetic and able Scotchman, James Braidwood, Esq., whose name our city now bears, was pit boss at one of the mines, and he soon convinced the officers of the C. and W. Coal Company that all the conditions existed here for the successful application of the "long wall" plan of taking out the coal. Less than a hundred tons a day was considered a fair "run" by one of the shafts on the room and pillar principle, and to get this limited amount out, the same top hands, such as engineer, banksman, laborers, carpenter, superintendent, pit boss, etc., as might attend the production of a much larger out-put, were employed. The company made the change, which was quite costly at first, but in a short time paid largely for the venture. At that time $2.75 per ton was paid for digging the coal and putting it on the cage at the bottom of the shaft. To-day it is dug at the rate of ninety cents a ton—that is the price paid the miner. Then, less than one hundred tons was a day's run; since then as much as one thousand one hundred tons, in ten hours, have been taken out of one shaft. Besides, as under the former system a great deal of money was expended taking up bottom in the railways, and a large proportion of the coal was lost, because many of the pillars were never recovered; now there is but little expense in keeping the bottom in repair, and every pound of the coal is extracted from the field.

Though the seam of coal is thin, one fact should not be forgotten or overlooked, which is, that it has a much larger outcome than many seams considerably thicker. You will see at a glance how this is, when it is stated that not one ounce of the coal is hewn away in undermining. This part of the miner's work is performed exclusively in the fire-clay, immediately below the coal bed, the clay being of such a nature as to make its accomplishment much easier than in the coal. Again, after the "bottom pillars" are cut, there is no cutting of the coal, or "shearing," as it is termed in mine parlance, and no blasting with gunpowder to fetch the coal down, after it has been bore in. Where such means are employed in coal mining, at least fifteen per cent. of the coal will be run into slack. This loss is rather under the mark. Thus, by this item of saving, we get from one thin seam the actual product of a much thicker one, for every square yard cut away. Another advantage, which to the operative miner is of the greatest importance, resulting from this method of production, is the uniform good ventilation of the workings. During the time the room and pillar mode was applied, fire-damp, or carburetted hydrogen gas, that most deadly enemy of the English and Pennsylvania miner, was in a small degree present. Then it frequently scorched the miner as he sought his working-place in the morning, and once in a while sent one hurriedly and dreadfully into the other world, "with all his imperfections on his head." When this deadly element played fantastic tricks, and rushed headlong through the many winding passages of the mine's caverns, momentarily illuminated by its own weird and bluish glare, and sweating boiling drops of molten fluid, while carrying destruction to the miner, also played havoc with the property of the company owning the works. Since the inauguration of the present principle, iis powers of mischief have been wonderfully clipped, and, if any thing like ordinary care be exercised, might be said to lie at the feet of science, impotent to work damage. It is seldom seen in our mines now, and this adds security to the health and safety of the miner, and to the property of the mine owners. Good ventilation in the mines is of such importance to all interested, that its benefits can not be overestimated It is a pleasing fact to chronicle, that in this coal field, with a few exceptions, the ventilation is excellent, leaving no room for a word of complaint.

All the shafts here, excepting one, have communication with some other. In other words, we have two distinct means of ingress and egress to the working-places of the miners. This is done to conform to the requirements of the statute of the State, "providing for the health and safety of persons employed in coal mines," passed by the Illinois Legislature in 1872. Although the law makes this obligatory upon all mine owners, or lessees, in this State, and very properly too, it is but right to state here, that the various proprietors have evinced a decided disposition to employ every agency that science and experience have shown, to assist in giving security to their workmen and property, law or no law. This is a commendable feature, and is appreciated.

All the safeguards now enforced by law in Great Britain, Pennsylvania, and your own State, such as pertain to machinery, the covering of the cages, careful and regular inspection of the ropes, boilers, signals, etc., are observed, and of fatal accidents, not one, in a series of years, has had to be noted in this district. To exhibit more fully the immunity we have had from fatal accidents, by any cause, the following short extract from our County Inspector's report of 1876, will suffice. He says: "In Will county, during the last two years, over one million tons of coal have been produced, and not one person killed by accident."

This is a condition of affairs which we can contemplate with supreme satisfaction. It is a substantial proof of the oft-repeated statements made by our leading coal miners, "that the number of fatal accidents in and around our coal mines, can and ought to be reduced to a mere nominal number, if the precautions science has provided, or experience demonstrated, were only put into practice." If this were done voluntarily by mine proprietors—and there can not be the least question as to its profitableness, from an economical point of view—we would hardly need a law to enforce their adoption. By and by we will have as high a standard for mine managers and oversmen, before they are put in charge of coal mines, as they have in England, and when that time comes, all the improvements a judicious, well-digested public policy would enforce, will be put into practice as a matter of course.

The following analysis of our coal was prepared by the State Chemist, Dr. Joseph A. Sewell, of Bloomington, Professor of Chemisty in the State Normal University, from samples taken out of the Diamond Mine, belonging to the C. and W. Coal Mining and Manufacturing Company, of this place:

Specific gravity		1.2975
Parts in 100:		
Water	6.983	
Ashes	5.972	
Total incombustible matter		12.955
Coke	53.377	
Ashes	5.972	
Fixed carbon	47.405	
Volatile matter	39.642	
Total combustible matter		87.047

Summary—Diamond Mine.

Water	6.981
Ashes	5.972
Hydro carbon	39.642
Fixed carbon	47.405
Total	100.000

In three specimens I found a trace of sulphur in one; in the other two no trace whatever.

Diamond Mine—Analysis No. 2.

Result of analysis of coal taken from mine two and a half miles north-west from Braidwood Station:

Specific gravity		1.2976
Parts in 100:		
Water	7.013	
Ashes	5.287	
Total incombustible matter		12.300
Hydro carbon, or volatile combustible matter	39.761	
Fixed carbon	47.939	
Total combustible matter		87.700
		100.000

No trace of sulphur in three specimens examined.

For steam purposes this coal has not a superior in the State, and is now making considerable headway for domestic purposes. It is used in many manufactories, for making steam, in Chicago, and in locomotives on the North-western railways. At the Joliet Rolling Mills it has been, and, when the mills are working, is now quite extensively used in the smelting of iron, after having been made into coke. At the Union Rolling Mills, of Chicago, it has taken a foothold, and is growing in favor. By and by, as prejudice in favor of some of our eastern coals, such as Erie, gives way before the results of actual tests, this coal will be used entirely, where at present it can not have even a trial. Such has been its history in the past. Undoubtedly it is not as good as your Ohio and Pittsburgh coals, but the difference in the cost delivered in our western cities, will do much to make up for its inferior quality.

The accompanying map illustrates the general plan in operation for the taking out of the coal in this field, and is taken from the original in the Chicago, Wilmington and Vermillion Coal Company's office in this city. It is the plan of their "G" shaft, which was burned down last winter by an over heated stove-pipe passing through the roof, and cost the owners in the neighborhood of twenty thousand dollars. E. Hall, Esq., the gentlemanly superintendent, kindly gave me the use of it to make the copy for your report. All the shafts, as before stated, are operated on the same principle, and those presently in operation differ from the first started here by Mr. Braidwood only in the main roads around the bottom pillars being driven inside the pillars, leaving a solid piece of coal between them and the *goaf*, whereas formerly the roads were all in the goaf, and outside the shaft pillars. This is claimed to be an improvement, in the fact that less timber work is required to render them secure and permanent, and I suppose it is so, as it is now pretty generally adopted by the different managers. (See plan.)

The idea in opening is to drive two levels or headings, with five "rooms" or "walls" between, on each side of the shaft, from whence are branched off all other rooms at a uniform distance of twelve yards, as near as it is practicable. Here and there the conditions surrounding the point where a branch is required, are such as render it injudicious, and it would be quite expensive, if pressed, to keep to the twelve yards exact; hence on the maps and in practice there are frequently great inequalities in the distance, though the design is to keep as near as they can to that figure. Twelve yards has been adopted on the ground that when the present method was begun two men worked in each place, and they hired a third who did the "pushing" or "wheeling" of the coal to the bottom of the shaft, or to the "ley" or "siding," as the case might be. Working to advantage, one-half of this space, and one more yard the half width of the roadway cut out about three feet, yielded enough coal for one day to pay all three. The manner of doing this is to keep the wall-face always, or as far as possible, undermined, as a rule two and a half feet in. Thus prepared, the weight of the strata overhead breaks the coal, and it falls forward on a range of short props or "sprags" which the miners have put in place. In placing these sprags care is taken to leave room for the coal-bed to simply loosen sufficiently that it can be easily let down in sections as it is wanted, and the roof properly secured. Herein lies much of the skill of the miner in this branch of his work; for, while the coal wants to be broken, it is also essential to have it act as a support to the top or

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TILDEN FOUNDATIONS

ceiling till it is taken out and substituted by props as supports. This is more particularly the case when the roof is brittle, soft, and badly broken, as it frequently is in some of the shafts of this field. When this is so, both skill and vigilance are called into play to keep the top from falling in, a great misfortune to the men working in that place, and those in places contiguous on either side, as it makes the work of getting coal much more difficult and deranges the ventilation. To keep men up to their best efforts in this matter, quite a stringent rule is enforced by the managers of the respective companies. Men who let their places "fall in," that is, allow the top to tumble down, and thus obstruct the passage of the air, are compelled to clear it out again at their own expense. On very rare occasions, where the strata are *very* soft, small allowances may be made, but these are extremely exceptional. Seven yards of wall-face, cut out a yard deep, will produce nearly seven tons, and this has always been considered a fair days' work for two miners and a pusher. As the mines are now worked, three miners are employed in one place, sometimes more, and the pushing or hauling is done by men who contract to do the work for so much a ton for every fifty yards traversed with the coal. The miners have had the letting of this work to contractors, and they received four cents a ton for every fifty yards the coal was hauled after the first fifty—nothing was allowed for it. Now, I learn the companies will manage this department of the work through parties employed by themselves directly. Although some men claim the change from two to three miners in one room was a detriment to them, I do not think it was. Indeed, I am of opinion the change was a decided advantage to them and the coal companies. Three miners can take care of a room nicely of fourteen yards wide, and drive it forward three feet every twenty-four hours they work; that is, take out seven yards of wall-face one yard deep every working day from either side of their roadway, and do the "gobbing" that this requires. To do this is good, fair work, but in no way oppressive; whereas, when two miners and the pusher, who was simply a common laborer, did it, it was too much, and made them liable to do the work imperfectly, inviting the falling down of roof and the closing of roadways. Taking out the coal is only a part of the miners' work, although to do it well requires skill that can only be acquired by years of experience. To take out the coal and keep in order all the surroundings is quite a job. Managing the surroundings is of as great importance in the work of excavating as the actual coal cutting itself. Very little, if any, powder is used in this work; in the matter of taking down the coal, I might say not any at all. Usually the coal intended to be taken down and sent to bank to-morrow is undermined and prepared for breaking to day. That which was so prepared yesterday is taken out to-day, and a space equivalent to what it leaves built in or "gobbed" with the rubbish taken out of the mining and roadway. Very often the manner in which this work is done determines, in a great measure, the efforts called for in getting out the coal for the day following. If done imperfectly, unless the conditions are so much more favorable, it is only a question of time till the place will go so far out of order as to compel a large amount of extra work to put it right again. Thus, in a measure, if one set of men intend to work for any length of time in a room, they reap, as in nature, what they themselves sow. The writer has seen many cases in his experience where due care, and no more work than was actually performed for a month or two at a critical place, would have saved men many extra shifts and great inconvenience which followed poor work for many months afterward, which they had no way of evading. Here is displayed the great difference in men in mining as in mechanics and other trades. Too often mine proprietors or their managers do not give the attention to *how* the work is done if a great number of tons is produced. As the practice is to pay so much a ton or bushel, they think it does not matter a great deal which way men dig it if it is only dug; but it does, and this fact every competent, careful mine manager knows. To make more slack than is unavoidable, for example, is a waste, and some men make much more than others; to do defective work that obstructs the regular and smooth running of the mine, or any section of it, is a waste; to allow one's roadway or room to needlessly close in, and thus interfere and partially destroy ventilation in any part of the works, is a waste; to be compelled, by carelessness or incompetency, to use one or more props than is required to do the work, is a waste; and in many other ways a poor workman is a poor investment, even though their inferior work may pass unobserved, or appear of no great consequence when done.

Running those rooms parallel with each other, and keeping the "branching roads," or "headings," on the outside, is to distribute the pressure as evenly as possible, and keep it from concentrating on those branching roads, which would be the case if they were run side by side with less space between. To have them close together would give a great deal more labor, which is money, in keeping the roof of these main roadways, besides costing much more for timber as supports. Timber, at this place, costs $6.00 a cord, and when so much of it is used, it is an important item in the cost of production. The rooms are turned from those two roads on each side of the shaft, and rarely from any other. The cost of putting in each branch, and doing the extra work connected with it, has been $5.00, and is paid to the men working in the level, or heading, from which the branches are made. They put in the pillar, which is of wood, and in this shape ■, and about four feet each way; cut down enough of the roof to admit of a car turning off their road, when new hands step in and work the place. This, and the cost of putting in the switch, is all the expense incurred in setting off a new place in those works.

Having run those branch places up to what is considered a paying distance—say two hundred yards—a good road in a range is then selected, heightened and repaired so as to admit a mule, and what is termed a "cross-road," commenced as near the working-face as it is thought to be safe from serious crushing or settling down of the roof, and is ran along through the goaf or gob several places on either side, thus cutting off the cost of pushing. The cost of running these roads is about $3.00 a yard, and the timber, and they are usually made six feet wide and six feet high. The saving resulting from the pushing money soon pays back this outlay, besides, to have a short road to push the coal is more satisfactory to the miner.

In the matter of ventilation, the long-wall system is a boon to the manager. Blunders, and a defective current resulting from them, can be made, but they must be the result of carelessness or absolute incapacity, because there is not the slightest excuse for the absence of a steady and adequate current passing along the working-faces all the time. Every circumstance is favorable to pure and first-class air currents around all the working-faces, and to men who give it any attention at all, knowing their business, no serious obstacle in this department need ever arise.

Though this be so, I have often known bad and inefficient ventilation in mines here. Even now, complaints are not uncommon on this account; but they arise from sections in a shaft, caused, perhaps, by a place "closed in," or some other local cause of an accidental description, which a few days, or weeks at most, will repair and bring back to its normal condition without expense to the owners. To save this expense—and it would, in most cases, be trifling—quite a number of men are often punished in having to work in places full of deadly gases that are quite injurious to health, and would only require time to make them fatal. This condition of things the mining boss justifies only on the poor excuse that those above him compel him to observe an economy that will not admit of even that small cost. No one in authority ever says "to put a good current in such places is impracticable, or even difficult," for all know better, and the question of expense alone is the apology.

On the whole, however, our ventilation is excellent, and the nature of the gases emitted from the coal or surrounding strata require that it be so. Black-damp, or carbonic acid gas, is produced by the fire-clay or substratum—the bed being quite heavy—and from the semi soapstone above. This being the material making up the goaf or stowage, it also evolves large quantities, and has the air always more or less impregnated, however strong the flow of air may be. On this account, the ventilation of all our class of mines should be divided or split into a good many separate currents each ventilating a given section no greater than to keep it at least healthy to breathe. Managers could easily have this done, and yet not incur any great expense. The satisfaction arising from it would do more than pay for the outlay.

The only question with managers, in connection with the ventilation of the mines, is the matter of keeping their principal air-courses, leading in and out, large enough, and the space between the face of the coal and the goaf acting in that capacity. Where the miners live and work, it will naturally make its own passage round, and enough of it.

Fans are now used only to force the ventilation at those mines, excepting at the shaft of the Braidwood Coal Company. At it, Mr. Braidwood employs the exhaust steam from his hoisting engine, or the jet plan, for that purpose. Furnaces were employed at first here, but the danger to the property from fire was an objection that was easily raised, on account of so much timber being used in the construction of the top works. For this reason, more than any other, they were abandoned, and gave place to the fan. These are constructed on the exhaust principle, and are placed on top of the upcast shaft, where they are driven at a speed sufficient to give them a wonderful suction power. When they are large enough, they make an excellent ventilating apparatus, but my own preference is the furnace, well constructed.

The " G " shaft—which the map represents—before it was burned down last winter, employed, in and around it, over four hundred men. This number has produced as much as eleven hundred tons in one day, though it was exceptional. Eight hundred tons, however, was a common run for this number of men, which is a fair quantity from a vein of little more than three feet. It is reputed the best shaft in this section.

An attempt has been made during the present summer to introduce a coal-cutting machine in one of the mines. The undermining part of the work at this shaft is said to be very hard, and the pick makes but slow progress in cutting by hand. This fact, and the miners being on a strike against a reduction in price, and the great difficulty of getting green hands into this shaft has induced the amalgamated coal companies of this district (for the four leading coal companies are combined, and pool all their earnings), to try what iron, steel, air, and genius could do in this direction. Accordingly, a gentleman by the name of Horace F. Brown, who has been experimenting in Antrim, of the Blossburgh, Pennsylvania region, and more recently in the Brazil, Indiana, coal field, has been allowed to make a test of one of his machines here. The terms on which the trial is made evidences the great faith the inventor has in his ability to make it a success. He agrees to put the machine in, and gives a guarantee that it will undermine the coal thirty inches deep one hundred yards distance in ten hours time. If it fails to reach this standard, the companies are not required to buy it. If it does perform this work, then they obligate themselves to buy the right to manufacture and use any number of the machines they may require. To do the undermining in those hard shafts, it is estimated to be in the neighborhood of one-half the work of getting out the coal. This accomplished by machinery will materially lessen the cost of production, and place the field beyond the contingency of any serious labor strikes, one of which has prevailed here for the last six months.

From a conversation with the inventor, I learn the machine has actually fulfilled the work guaranteed, in proportion, and five beyond it. In consequence of the strike, and the men attending, or preparing the coal-face for its work being unacquainted with the workings, the machine has had no chance yet to run a whole day. The greatest distance cleared for it so it could cut at one spell was less than thirty yards. With ten pounds pressure, it has undermined fifteen inches to the minute, and with fifteen pounds pressure, it has cut five feet in one minute and fifty seconds. Mr. Brown feels quite certain the cutter will, when it gets fairly to work, undermine one hundred and fifty yards every day it runs, and has anything like fair play. Should it do so, it will undoubtedly work a revolution in the mining of coal in this field, and not only here, but many other places. Should it prove a success here, many places that are now operated on the room and pillar plan will give way to the long-wall system of working out their coal. Thus they will be compelled to do, as a matter of necessity, what they should now do, as a matter of economy.

The machine itself is much after the style of the Baird Bros. coal cutter, of Gartsherrie, Scotland. The distinctive features are, that in this machine the arm on which the cutters or picks are placed is adjustable, and can be raised up or lowered down, mining, either on a level plane with the pavement or above it, as desired. This is important, and is a decided advantage over the Baird machine, the cutting-arm on which is fixed. This arm, also, is adapted to adjust itself to the undulations i the bed of the coal, or whatever other mineral it may be cutting, and is a feature in itself. To this, however, is added the feed apparatus, which is driven by an engine separate from those that give motion to the cutters on the arm, and is always subject to the control of the driver. By this arrangement, the cutters can be made to take short or long slices of the material it is cutting, according to desire, as in sewing machines long or short stiches can be had at the will of the operator. No rails are required for the machine to run on, as is the case with all others that I have seen, except where water is on the bottom, which makes it very soft. In such a case only they are required. On the whole, the machine appears to me a most complete thing, and should be made to do the work intended. After a careful examination, my judgment is decidedly that it will be a success. It works inside of thirty inches clear, between the coal-face and goaf, or support-props.

Map No. 2* represents the plan upon which the Braidwood Coal Company Mine was began, and on which the owners of it intended to have it operated upon. The object was by this system to get the coal with less dead expense than attends the plan as illustrated by the maps of the C. W. and V. Coal Company. To do so, the calculation was to run the roadways, as entries, to the inside of a given distance, or a square, cut across upon each other through the pillars, and then win back the coal toward the shaft bottom almost in the same way as they would work away from it if working the "long wall" plan. To keep better main roads, the design was to leave a solid pillar on either side of each one. It was expected that little or no timber would be required in any of the other roads, and very little for the rooms. And in addition to this, the idea was that the pillars, in returning, could be cut for much less per ton than the regular work, seeing there would be less dead work accompanying the taking out of the coal. Under certain circumstances this plan may be very good, but in this field it is open to a number of serious objections, the more prominent being the first cost in getting the shaft prepared to produce sufficient coal to make any thing like a return for the money invested; the next is the length of time before it would do so, that is, the time it would take to get the entries driven, and a commencement made to take the pillars out, which would be a long time, do the best a manager could; the next would be that unless the pillars between the main roads and the goaf were left quite deep, the pressure from above, while it might not disturb the roof, would be apt to crush the pillars so as to force the bottom up, which is quite soft, and when it has water on it, will rise up, and gives great labor and expense in keeping it in order. These objections, if the plan have none else, will keep it from ever having much of a foothold here. If we had a field perfectly dry, a good hard roof and floor, and the owners in possession of a good deal of money to invest, and could afford to wait a good while for a return, then it might be better than the "long wall" plan, which is very doubtful. For such a vein of coal as we have, with the quality of top and bottom in connection with it, I am quite convinced that the "long wall" plan can not be supplanted by any other that will be more economical, or yield better results to all interested.

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* The cut of the above map was not received in time for insertion in this report.

THE COAL-FIELD.

The Great Appallahcian Coal-field, the largest known coal-field of the world, extends through portions of nine different States, namely: Pennsylvania, Maryland, West Virginia, Virginia, Kentucky, Ohio, Tennessee, Georgia, and Alabama, and covers an area of at least 50,000 square miles, being 750 miles in length, by from 30 to 150 miles in width. The State of Ohio occupies fully 10,000 square miles of this territory, the Coal Measures covering one-fourth of the area of the State. The western margin of the Ohio portion of this great coal-field runs through the counties of Trumbull, Geauga, Portage, Summit, Medina, Wayne, Holmes, Jackson, Pike, and Scioto, and the Coal Measures are spread over all the territory lying east of the line of outcrop, to the State line on the Ohio River.

The eastern flank of this great coal-field, opposite the western line of outcrop in the State of Ohio, runs through the States of Pennsylvania and West Virginia, about seventy miles east of the Ohio River. From both of these outcrops the strata dip inward to the basin or center of the field, which is situated in West Virginia, about thirty miles east of the city of Wheeling; and the Coal Measures, which are but a few feet in thickness on both outcrops, are over 2,000 feet thick in the basin.

On the extreme margin of the Coal Measures of Ohio, in the counties named above, there is but one workable seam of coal, covered with a few feet of shale and sandstone, while in the counties of Belmont and Harrison, on the Ohio River, the dip of the strata takes the horizon of this seam 1,500 to 1,600 feet below the highlands, and the strata contain, perhaps, forty different seams of coal, fifteen or sixteen of the seams rising to workable thickness at one point or another. The dip is very irregular, being sometime eighty to one hundred feet to the mile, at other times not more than ten to twenty feet, and it sometimes reverses itself, forming anticlinal and synclinal curves. The average dip is, however, about twenty feet to the mile, and the line of dip about south eighty degrees east.

As we pass from the extreme margin of the Coal Measures of the State, along the line of dip, toward the center of the great coal-field, one after another of the various beds of coal are seen to expose themselves in numerous ravines and valleys, on their line of outcrop, and finally to plunge under the cover of the valleys, to reappear only in the Pennsylvania and West Virginia margins of the coal-field.

The Coal Measures of Ohio have been divided by the State Geologists into three series, namely, "The Lower Measures," "The Barren Measures," and "The Upper Measures." The Lower Measures are from 400 to 500 feet in thickness, and contain seven, locally ten different seams of coal, which at one point or another of the coal area are of workable thickness. The Barren Measures, which are 400 to 500 feet thick, contain but one seam, which rises to two feet. The Upper Measures, about 600 feet in thickness, hold nine different, well-defined beds.

The lower coals have been named in the geological reports, No. 1, No. 2, No. 3, No. 3 A, No. 4, No. 4 A, No. 5, No. 6, No. 6 A, and No. 7. Nos. 3 A, 4 A, and 6 A are local beds, only appearing over limited parts of the coal area. The two-foot seam in the Barren Measures is a very persistent bed, and is as remarkable for its general evenness of depth as for its continuity. It is not named in the geological reports, though it well deserves to be. The upper coals are named: No. 8, No. 8 A, No. 8 B, No. 8 C, No. 9, No. 10, No. 11, No. 12, and No. 13. Nos. 8 A, 8 B, and 8 C have been so named in consequence of the opinion held by Professors Newberry and Stephenson, that they are simply off-shoots from No. 8, and that all four seams run together. The thin seams not enumerated in the geological reports are generally quite local, and never rise to a workable depth.

The thickness of strata which separate Coals Nos. 1 and 2 ranges in the Mahoning and Massillon region from 25 to 60 feet. If the Wellston coal, of Jackson county, be Coal No. 2, the distance between these seams, in this county, has increased to 150 feet. Coal No. 3, in the geological report, is located from 90 to 130 feet above No. 2, and No. 4 from 40 to 80 feet above No. 3. No. 5 is usually 60 to 80 feet above No. 4; No. 6 from 18 to 40 feet above No. 5, and No. 7 lies from 60 to 100 feet above No. 6. The inter-located coals, 3 A, 4 A, and 6 A, are, as their names indicate, wedged in between the seams whose numbers correspond with their own numbers, and number first above their own.

The two-foot seam of the Barren Measures lies about 250 feet above the horizon of Coal No. 7, and 700 feet to 750 feet above No. 1. No. 8, the Pittsburgh coal, the lower bed of the Upper Measures, lies from 250 to 300 feet above the two-foot coal of the Barren Measures, 400 to 500 feet above Coal No. 7, and 900 to 1,000 feet above the horizon of Coal No. 1. The eight coals of the Upper Measures, overlying the Pittsburgh bed, are distributed throughout the 600 feet of strata in the hills fronting the Ohio River, in Belmont county, in the following manner: No. 8 A is 24 to 30 feet above 8; No. 8 B is 20 to 25 feet above 8 A; No. 8 C is 25 to 30 feet above 8 B; No. 9 is about 110 feet above 8 C; No. 10 is about 40 feet above 9; No. 11 is about 100 feet above 10; No. 12 about 40 feet above 11, and No. 13 about 80 feet above 12. The sections taken at Barnesville, in Belmont county, 25 miles west of Bellaire, are, as I have said, believed by some of our geologists to show a coalescing of Coals Nos. 8 A, 8 B, and 8 C with 8; that these four seams separated from each other at Bellaire, in the manner I have described, all run together at Barnesville. In this view I am unable to agree, and hold that the Bellaire and Barnesville sections show the same seams of coal, and that instead of any coalescing of the beds named, they rather diverge in passing westward, coals No. 8 and 8 C, which are 80 to 90 feet apart in the Bellaire district, being 90 to 100 feet apart in the Barnesville district.

All the beds occupy wavy and uneven floors, each seam waving in a series of synclinal and anticlinal curves, independent of the local dips and rises of its associate seams.

These local dips and rises cause the seams to converge and diverge, two seams 70 feet apart at one point coming within 30 to 40 feet of each other in quite limited intervals. Some marked cases of this character occur with Coals No. 1 and No. 2. No. 1, usually found occupying a series of long, serpentine troughs, separated from each other by hills from 10 to 60 feet in height, frequently rises up a hill and descends into an adjoining swamp with a pitch of 15 and 20 degrees. No. 2 invariably conforms to the curves of No. 1, though in a less degree in ascending order. In the swamps, where the two coals are separated by say 40 feet of strata, the interval becomes reduced, on the hill-sides, to 30 feet or less.

While Coal No. 2 invariably conforms, in a greater or less degree, to the dips and rises of Coal No. 1, there are sometimes instances where the upper coal shows local waves by which the lower coal is in no wise affected. This is a condition the result of erosion in the floor of Coal No. 2, before the carbonaceous material which subsequently formed the bed was deposited. In the higher beds of the Lower Measures, as also in all the seams of the Upper Measures, troughs or basins scooped out of an originally level plain anterior to the deposition of the coal vegetation are met wherever the mining developments have given opportunity of investigation. In the mines of Salineville, opened on the Big Vein, on the north side of Yellow Creek, the entries, advancing northward, rise gradually. When they reach a height of about twenty feet from the trough or basin, the roof of the mine changes from a gray shale to a white roof, exactly as the changes occur in the hill-sides in the mines of the Mahoning and Tuscarawas Valleys, opened on Coal No. 1. The coal then thins out with the next few yards of advance.

In the mines of the Glasgow and Port Washington Iron and Coal Company, also opened on Coal No. 6, the sides of a trough, scooped out of an originally level plain, is exposed to the naked eye in passing along the main entry from the mouth of the mine. The coal floor, for one or two hundred feet, is taken up to make the road level. For two and a half feet below the coal the strata, equally with the coal and the coal roof above, pitch at an angle of fifteen or eighteen degrees, while the strata below are perfectly horizontal. The sides and bottom of the old trough, two and a half feet below the coal floor, are marked by a well-defined layer of fire-clay, an inch or two in thickness.

The old plains or marshes on which the various seams were formed, were also wavy in character, the result of conditions in which erosion had no part. These hills are sometimes one hundred feet in height; there is no coal on their summits, and the horse-backs, invariably met on their sides, are the result of shore waves lashing the knolls during the subsidence of the land. A hill on Coal No. 5, at the Del Carbo Mines, in Muskingum county, brings that seam up within twelve or fifteen feet of No. 6, and a swamp in No. 6, at Coshocton, brings that coal down to within ten or twelve feet of Coal No. 5. In the two air-shafts of Bowen's Mine, near Millersburg, in Holmes county, both of which pierce down through Coal No. 7 to No. 6, these coals are sixty-six feet apart in one shaft, and forty-five feet in the other; one shaft being sunk on a hill nearly thirty feet high, and the other in or near a swamp. At the Plummer Hill Mines, in Perry county, Coals Nos. 5 and 6 are thirty-five feet three inches apart at the cave, while on the adjoining property of the Central Mines, on Lost Run, these coals are only twenty-one feet seven inches apart.* Coal No. 7 is seventy feet above Coal No. 6, on the south side of the Central Mining property, while on the north side of the same property—the distance being less than half a mile—these coals are ninety-two feet apart.

In addition to the local waving of the Coal Measures, there is frequently a gradual thickening of the strata between two coals for many miles at a stretch. In the Mahoning Valley, Nos. 1 and 2 are only twenty-four to thirty feet apart in the swamp, in the east part of Hubbard township, Trumbull county; while at Mineral Ridge and West Austintown, ten to twelve miles west, the strata have increased to fifty and sixty feet. Coal No. 7, which is from fifty to sixty feet above No. 6, near Moxahala, in Perry county, is ninety to one hundred feet above it in the lower Sunday Creek at Chauncy, in Athens county, ten to fifteen miles southward. Frequently a seam will split up into two benches, the intercalated material, usually gray shale, increasing in thickness, in certain lines of direction, to twenty feet or more. The great, thick coal of the Hocking Valley, measuring, in Perry and Athens counties, eleven and twelve feet, is formed by the union of two coals. The two benches are together in one part of the Floodwood Mine, and in another part of this mine they are separated by two, three, and four feet of shale. At Shawnee, where the bed is nine and ten feet in thickness, the coal splits up again and becomes reduced in height to five and a half feet, the upper bench thinning out altogether. Coal No. 4 shows a remarkable tendency to split up into two or more benches.

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* A clerical error occurs in my last annual report, in a measurement of the distance between Coals Nos. 5 and 6, at the old Straitsville Mine. The distance between these coals at this point, is twenty-nine feet ten inches. The report reads "twenty feet ten inches."

The materials which separate one seam of coal from another, are composed of alternate sheets of shale and sandstone, with occasional beds of limestone, iron ore, and fire-clay. The sandstones and shales, which form the mass of strata, are subject to frequent and rapid changes in thickness. Generally, the immediate cover of a coal seam is dark or gray shale, though sometimes it is sandstone; where the roof is sandstone, the coal is largely impregnated with iron pyrites, and is consequently of less value. The sandstone roof is also liable to cut into the coal, removing part or the whole of the bed, forming a horse-back in the mine.

The coal beds in their progress through the coal area are subject to marked changes in character and thickness. No. 1 is a purer and better coal in the Manoning Valley, than in any other region of the State, and it is also much purer and better in one mine than in another in the same region, and sometimes even in the same mine; and this is equally true of other beds. On the east side of the Mahoning River, the seam is very generally a long-grained block coal, in a homogeneous mass, and having a cover of shale; while on the west side of the river, it is generally a short-grained coal, and lies in two benches, a stratum of shale, capped with a bench of black-band ore, jointly ranging from one to five feet in thickness, separating the benches, and the roof is often a conglomerate sandstone. The changes in thickness of this bed are more marked than the varying quality of coal. Resting in basins or troughs, it becomes reduced from four and five feet in the swamp, to a foot and eighteen inches in the hill-sides, in a few hundred feet, losing thickness in proportion to the abruptness and height of the hills in the mines. The average workable height of coal in the swamps is about four feet, though it occasionally rises to six and seven feet. Coal No. 2, in the Massillon and Mahoning regions, is generally thin, usually less than eighteen inches, and seldom rises to workable thickness. Coal No. 3 is worked at the Canfield Shaft, in Mahoning county. It lies about twenty feet below the gray limestone, and is about one hundred and sixty feet above the horizon of Coal No. 1. This coal is generally supposed to be No. 2, but a careful examination of the strata has shown that No. 2 is one hundred and twenty to one hundred and thirty feet below it. The Canfield Shaft coal, which is fifty feet below the surface, on the line of the Niles and New Lisbon Railroad, is from eighteen inches to three feet in thickness, and possesses a general average thickness of two and a half feet. It is a block coal, of excellent quality, and despite its thinness, and consequent increased cost of mining, competes successfully with the best block coals of the Mahoning Valley in the Cleveland markets.

Coals Nos. 3 and 4 are wanting altogether, or are present only as mere traces over the greater part of the coal area, and in their best development they seldom rise to four feet in thickness. No. 5 is much more persistent than any of the four seams below it, but it is generally a thin coal, though it occasionally swells to good workable height, being four and five feet thick at Zanesville, at Steubenville, and some other mining centers. No. 6 is the thickest and most persistent bed of the lower series, but, like all its associates, it has varying features. It rises to twelve and thirteen feet in some places, in the Hocking Valley region, and recedes to three, and even to two and a half feet along the line of the Cincinnati and Muskingum Valley Railroad, and the Muskingum River. It swells to eight and nine feet in the Rush Run Shaft, twelve miles below Steubenville, and contracts to two and a half feet, or less, in the Mingo Shaft, five miles below Steubenville. It is six and seven feet thick at several points in the Salineville district, and is less than three feet thick in the same district. No. 7 is a very persistent seam, and generally returns a workable thickness, though it occasionally thins to a mere trace, or disappears. No. 8, the Pittsburg coal, is the prince of beds, not only in the Ohio Coal Measures, but all over the Alleghany coal-field. Wherever it is due, it is rarely wanting, and wherever met, it almost invariably appears in good height. It is often a double seam, a wedge of shale or fireclay, from one to three feet in thickness, separating the two parts. Of the eight seams above the Pittsburgh coal, less is known than of the coal of the lower measures. Along the line of the Baltimore and Ohio Railroad, between Bellaire and Barnesville, most of the upper coals have been laid open in the cuts of the railroad, and every seam of the series has been opened, at one point or another, in Belmont county, by t farmers, for home consumption. In this part of the coal-field, all the seams are found in place, and they appear to be persistent, though some of them, notably 8 A, 8 B, and 11, are often less than two feet in thickness. Further down the Ohio River, at Marietta, and at Pomeroy, there seems to be no extended workable coals in place, above the Pittsburgh bed.

The various beds, in thinning down or in gaining height in any line of direction, are not, in the lower seams at least, affected by any general law. One seam may be gradually losing height over a given line of direction, while the seam immediately above or below may be gaining height. Where a bed sinks into a hollow, formed before the coal was deposited, there is an invariable increase in thickness; but this is a local condition.

The aggregate thickness of the whole coal series, were all the seams in place, one above the other, where they are due, would exceed a column of eighty feet; but, as none of the four lower coals are reliable, being, as I have stated, wanting or worthless, over the greater portion of the coal field, and as all the seams of the series, with the exception of No. 6 and No. 8, frequently disappear, or become so reduced in height as to make them of no commercial value, there is probably no part of the coal-field where they will aggregate thirty feet of thickness, and the general average over the whole coal area will not exceed nine feet. The beds of the upper series, it must be remembered, occupy less than one-fourth of the area of the lower seams, owing to the basin slope of the coal-field. By this calculation, there would, after due allowance is made for slack and waste in mining, still be 62,900,000,000 tons of merchantable coal in the coal-field of the State, which, at the present rate of consumption, will keep up the coal supply for 12,590 years. The annual coal production will, however, not remain stationary, but will doubtless double itself every ten or twelve years, for many decades; still, no matter what may be the increase in the yearly output, there can be no danger of a coal famine for many decades of centuries.

We could, at the present rate of consumption, supply the United States with coal for nearly 2,000 years; and the United States is now the second coal-producing nation of the world.

The coals in present course of development, are chiefly drawn from three seams, namely: No. 1, No. 6, and No. 8. No. 1, as already stated, is the Briar Hill and Mineral Ridge coal, of the Mahoning Valley; the Massillon coal, of the Tuscarawas Valley; and the Shaft coal, of Jackson county. No. 6 is the Nelsonville, the Straitsville, and Shawnee coals, of the Hocking Valley; the Steubenville Shaft coal, of Jefferson county;

the Coshocton and Dennison coals, of the Tuscarawas Valley; the Big Vein coal, of Salineville; and the State Line coal, of East Palestine. No. 8, generally referred to as the Pittsburgh coal, from its being the geological equivalent of the seam so extensively mined around the city of Pittsburgh, is the Pomeroy coal, the Bellaire coal, of the Ohio River, and the Macksburg coal, of Noble and Washington counties. Of the other beds of the series now being mined, No. 3 is the Canfield Shaft coal, in Mahoning county, and, perhaps, the Wellston coal, of Jackson county. Nos. 3 and 4 are the Washingtonville and Leetonia Shaft coals. No. 5 is the lower Lexington coal, of Perry county; the lower coal, of Zanesville, in Muskingum county; the Tunnel and Mineral Point coals, of the Tuscarawas Branch of the Cleveland and Pittsburgh Railroad; and the Roger Vein, of Yellow Creek. No. 7 is the Salineville Strip vein, and the Bayley's Run coal, of the Hocking Valley.

None of the upper coals, except the Pittsburg seam, are wrought to any extent in the State. Nos. 9 and 10 are opened, and mined for local uses, in Belmont and Harrison counties.

The lower series, occupying the margin of the coal area, are mined and shipped to the great coalless regions lying west and north of the coal-field, while the upper coals, more distant from market, are unable to compete, and pay the increased cost of transportation. The Pittsburgh coal, remarkable alike for its superior quality and thickness, is shipped, to some extent, to Cleveland, but the chief point of shipment of this coal is down the Ohio River.

I have named the two coals of the Leetonia district, Nos. 3 and 4, on the authority of Dr. Newberry. There are some facts, however, associated with these coals at Leetonia, and Washingtonville, which lead me to suggest that they may be Coals Nos. 6 and 7—the equivalents of the lower and upper seams of East Palestine, and of the big vein and strip vein of Salineville, instead of Nos. 3 and 4. Both beds at Leetonia, and Washingtonville, are underlaid with a band of limestone, a very frequent accompaniment of Coals Nos. 6 and 7. There is, also, very generally a band of limestone above No. 3, and another band of the same material above No. 4. The limestone above No. 4, is the equivalent of the ferriferous limestone of Southern Ohio, erroneously located about No. 6, in the geological reports. The limestone overlying Coal No. 4, is the most persistent bed of limestone of the whole series of rocks of the coal measures of the Alleghany coal-field, being the equivalent of the ferriferous limestone of the Hanging Rock region; the Putnam Hill limestone, of Prof. Andrews' report, and, also, in my judgment, the ferriferous limestone of the Pennsylvania geologists.

The upper coal at Leetonia and Washingtonville has also a seam of black band iron ore above the coal.

The black band ore of the Tuscarawas Valley, as is well known, lies immediately above Coal No. 7. This is also the horizon of the Iron Point, of the Hocking Valley, which is sometimes black band. In Salem Shaft, which is sunk down through both of the Leetonia coals—the lower coal being 180 feet deep, and the upper one 140 feet deep, in that shaft—no trace of Coals Nos. 5 and 6 are seen, the horizon of No. 5 being about eighty feet above No. 4, and the horizon of No. 6 being about twenty-five feet above No. 5. Coal No. 6 is the most persistent, as it is the thickest seam of the lower Coal Measures, and is seldom wanting over any extended area, while Coals Nos. 3 and 4 are frequently absent. I have not followed the coals of the lower series, from Mineral Ridge to Leetonia, as they plunge, one after another, under the valley, but have followed them from the Ridge to the Canfield Shaft, and am fully convinced that the coal in that shaft is No. 3, and not No. 2, as is generally supposed—its horizon being 160 feet above Coal No. 1, and 120 feet above Coal No. 2. The cannel coal of Canfield township—the Bruce vein—is still higher up in the series than the Canfield Shaft coal; and the lower coal at Leetonia, is still above the Bruce coal.

Coal No. 1 has so far only been found along the outcrop of the coal-field of the State, and it is believed by many intelligent, practical miners that it does not exist in the central portions of the Coal Measures. Some of the geologists hold that, while Coal No. 1 was forming in the troughs or swamps in which we find it imbedded, the central portion of what is now the Great Alleghany coal-field, was a shallow sea, in which no coal vegetation was capable of growth, and so far as the Ohio division of the great coal field is concerned, there are good grounds for this belief. There are equally good reasons for believing that the conglomerate rock is also confined to the margin of the Coal Measures of this State. Outside of the Coal Measures, this rock is frequently quite thick, reaching, and even exceeding, one hundred feet in depth; but as it plunges under the coal-bearing rocks, it becomes gradually thinner. In all the mines of the Mahoning and Tuscarawas Valleys, opened on the extreme margin of the coal strata, the conglomerate is met on every hill, but it is thin, while in those mines opened on the same seam, further in the interior of the Coal Measures, the pebbly sandstone has thinned out altogether, the coal, both on hill and dale, resting on the Waverly sandstone, or on a thin seam of fire-clay, which covers the Waverly.

The Elk Fork coal, the Vinton Shaft coal, the Wellston coal, the Anthony coal, and the Jackson Hill coal are equivalents. This seam appears to have its best development in the vicinity of Wellston, rising above four feet at several points, and at all points retaining a workable thickness. On Elk Fork, the thickness is from three to three and one-half feet.

From ten to forty feet above this coal there is an upper stratum, but it is not persistent, and is usually quite thin, though it sometimes rises to workable thickness. This seam possesses the open burning nature of its lower associate. This is the hill coal of Prof. Andrews' reports.

The horizon of the ferriferous limestone, is from one hundred and seventy to two hundred and ten feet above the lower of these two beds, and in the interval, there are two, sometimes three, seams of coal, and two or more beds of limestone. The first coal of value in ascending order is the Newland coal of Elk Fork, the equivalent of the Dowd coal at Zaleski, The horizon of this seam is eighty-five to one hundred and twenty-five feet above the Wellston coal, and twenty to forty feet below it the lower limestone appears. The middle limestone overlies the Newland coal, frequently forming the roof of the seam. This limestone is not persistent, and, where wanting, is replaced by a stratum of dark, often calcareous shale. Its horizon was still above this coal-bed.

On Dr. Wolf's speed-farm, half a mile north of the village of McArthur, the Elk Fork coal was not exposed, and was supposed to be under the bed of the creek. Seventy-two and one-half feet above the creek level a stratum of blue limestone, capped by a mass of calcareous shale, crops out on the hillside. One hundred and forty-three feet above the level of the creek an abandoned coal mine, the entrance to which had fallen in, is met. This coal is, no doubt, the equivalent of the upper coal of Dr. Wolf's Elk Fork Farm. Fifty-eight feet above this coal, the ferriferous limestone appears, making this limestone two hundred and three feet above the level of Elk Fork, and about two hundred and twelve feet above the Elk Fork coal.

At Hamden Furnace, one mile north-east of the village, the ferriferous limestone caps the highest hills, and is wanting to the west. The limestone is not persistent, and is of irregular thickness, receding to nothing, and enlarging to fifteen feet. The one does not always lie immediately upon the limestone, but sometimes rises three feet above it, the intercalated material being clay shale. The ore is also frequently wanting, and again enlarges to three and four feet. On the Elk Fork branch of Big Raccoon Creek, four miles west of McArthur town, on the Zack Stephens' farm, the ferriferous limestone caps the highest hills and disappears forever to the west. Coming eastward from the Stephens' farm, this limestone dips and is met in every hill. At Vinton Station, on the Marietta and Cincinnati Railroad, it is only fifty feet above the track, and has a cover of fully one hundred feet.

The Elk Fork coal is a few feet below the bed of the creek, on Dr. Wolf's Elk Fork farm. Eighteen feet above this coal a stratum of coal, ranging from four inches to one and a half feet in thickness, is exposed. One hundred and twenty-one feet above the Elk Fork coal, the Newland coal is exposed; the seam is said to be four feet thick. This coal is frequently capped with a blue limestone, and where the limestone is wanting, the cover is calcareous shale. Twenty-one feet above the Newland coal a stratum of ore, called the Benson Dunkle ore, crops out; its thickness is from one to three feet. Twenty feet above this one, and forty-one feet above the Newland coal, another seam of coal is met. It is said to be four feet thick, but was not opened. The ferriferous limestone was not exposed. A new shaft sunk one mile south of Wellston, on the line of the Dayton Narrow-Guage railroad, is eighty-five feet deep and has three feet ten inches of coal. Fourteen feet above the floor of the coal there is a thin seam nine inches thick. This is the equivalent of the thin coal on the Elk Fork farm of Dr. Wolf.

Passing along the line of the Dayton railroad, the Wellston coal appears to be continous, and is met in full thickness wherever the coal-borers have sunk for it. On the Lucas farm two mile west of the Dayton shaft, the coal is forty-eight feet below the surface, and one mile west of this drill hole it is only twenty-eight feet deep.

Where this railroad crosses the old Hamden road, on the Frank Scott farm, the coal comes to day, and is afterward level free.

Leaving the line of the railroad, at the Washington Meeting-House, and passing up Pidgeon Creek, this seam is buried half a mile west of meeting-house, on an arch which divides Pidgeon Creek from Hope Creek. In less than one mile it re-appears and gradually rises, till it finally crops out on the hills on the McKitrick farm, one-half mile south of Jackson Court House.

A level from the mine opened on the McKitrick farm toward Jackson, strikes the dome of the court house at its base. A mile east of the court house, and two and a half miles from the McKitrick Mine, the coal comes in again in place, but is too thin for mining purposes, measuring only fifteen to eighteen inches.

A level taken from the lowest coal in the Star shaft, to the base of the dome of the court house, shows the horizon of the McKitrick coal to be 175 feet above the shaft coal. In this level no account is taken of the dip of the strata, but after due allowance is made for the dip, the true place of the Jackson Hill coal can not be less than 150 feet above the

Jackson Shaft, coal in the swamps of the mine is 110 feet above the shaft coal in the high arches or hills of the mine.

All the coals of the State series belong to the bituminous variety, and consist of three different groups, known as "open-burning coals," "coking coals," and "cannel coals." The open-burning coals, also called "block coals," and "dry coals," possess a laminated structure, and are easily split up into thin layers, the faces of which are usually covered with a dead carbonaceous material resembling charcoal. In the act of combustion, these coals neither smell nor change form until they fall to ashes, and hence they are admirably adapted for furnace use in a raw state. The lower coals of the series often possess this open-burning quality, and is largely used in the blast furnace in consequence, as it comes from the miners' pick, both in the Mahoning Valley and in Jackson county, and to some extent, also, in the furnaces of the Massillon district.

The Wellston coal of Jackson county, which I have designated as probably Coal No. 2, possesses this open-burning character, and is thrown into the furnace as soon as it comes out of the mine.

The coking coals, also called "cementing coals," melt and run together while burning, and hang in the furnace, forming a hollow fire, and hence, before being fitted for furnace use, require to be coked. The upper coal of the Leetonia and Washingtonville mines is a good cementing coal, and makes one of the best cokes in the State. Coal No. 6, at Salineville, at Steubenville, and other important mining centers, is coking in character. No. 8, wherever mined in the State, is also in a greater or less degree a coking coal.

The cannel coals are smooth, hard, and compact, break with a conchoidal fracture, and are admirably adapted, when in a pure state, for the parlor fire and for the manufacture of gas. They contain a large per cent. of hydrogen, burn with a clear, bright flame, and the gas made from them possesses brighter illuminating power than that made from any other variety. Although our coal series contain quite extensive deposits of cannel on several horizons, no deposit of first-class quality has yet been discovered, and at the present time there is little, if any, cannel mined anywhere in the State. This kind of coal changes to the ordinary variety, and from the ordinary variety back to cannel, at quite limited intervals, in many of the coal-seams of the State. Sometimes the top part of a bed will be cannel, sometimes a wedge of cannel will be found in the middle of the bed, and sometimes the bottom part of the bed will be cannel, occasionally the whole seam throughout becomes transformed into cannel.

In every coal seam opened in the State there are faults encountered in mining in the form of "clay veins," "wants" or "wash-faults," "slip-dikes," "rock-faults," and "horse-backs." Clay veins are oftener met in the Pittsburgh coal than in any other seam of the series. Wants or wash-faults are very common; they come from the roof, are generally composed of sandstone, and extend from a few feet to hundreds, sometimes thousands, of yards in thickness, cutting out part or whole of the seam. Slip-dikes, so common in British and other coal-fields of the world, are rarely encountered in Ohio, and, when met, are invariably slight upthrows or down-throws, the largest only reaching six to seven feet. Rock-faults, in the form of layers of sandstone, or shale, or bastard cannel coal wedged in the middle of the coal seam, are of frequent occurrence. Horse-backs, in the form of ridges or saddles, which rise out of the coal floor, and resemble a horse's back, occur more frequently in the Pittsburgh seam than in any other bed. The name, "horse-back," is now, however, very generally applied to all mining faults, though the true horse-back, as its name indicates, is the saddle-like roll found in the coal floor, so familiar to workers in the Pittsburgh coal seam. Wash-faults are the most frequent of all mining troubles; these faults are now always called horse-backs.

IRON ORES.

The ores of iron associated with the beds of coal in the Coal Measures of the State are known by the general names of blackband ore, limestone ore, block ore, and kidney ore. The blackband, at the present time, s mined only on two horizons—that of Coal No. 1 in the Mahoning Valley, and Coal No. 7 in the Tuscarawas Valley. This ore is a dark grey bituminous shale, with thin reddish streaks interstratified through it. Wherever it is found in the mines of the Mahoning Valley, it ranges rom four inches to a foot in thickness, and is wedged in the middle of the coal seam. In its best development in the mines, it yields a ton of ore to the ton of coal mined; but one ton of ore to three tons of coal is about the general average. In mining the ore, pieces of coal often stick to the bottom or top of the bed, and frequently thin layers of coal run through the middle of the bed which serve for fuel in roasting it. In its raw state, it yields usually from twenty-five to thirty per cent. of metallic iron, and when calcined, from fifty to fifty-five per cent.

The blackband ore of the Mahoning Valley was first used in the blast furnaces of the region in the year 1852. For some time after the mines were opened, the ore, on being mined out with the coal, was thrown into the gob with the slack coal and other refuse. At length a miner from one of the blackband districts of Great Britain, called attention to its properties and value, and it was raised to day, roasted at the pit's mouth, and tried in the furnace, mixed with the limestone ores of the region and the specular ores of Lake Superior, with the most gratifying results. The iron made from these mixtures is widely known as a superior brand of foundry iron called American-Scotch.

Wherever it is found associated with Coal No. 7 in the Tuscarawas Valley, the blackband ranges from six inches to sixteen feet in thickness. It lies on top of Coal No. 7, forming the immediate cover of the bed. Its best development in the Tuscarawas Valley is around Port Washington and in Fairfield township. In appearance the iron stone resembles the blackband of Mahoning Valley, and yields about the same per cent. of metallic iron. It has been mined in the Tuscarawas Valley for upward of forty years.

Both in the Mahoning and Tuscarawas Valleys the blackband is very irregularly distributed, and is often wanting where it is due. In the Mahoning Valley, it thins out on the arches which separate adjoining swamps, and is found only in the mines around Mineral Ridge, the seam of coal in other parts of this valley being found in a homogeneous mass. In the Tuscarawas Valley it appears to occupy a series of shallow basins, and to thin out to a point on the edges of these basins. Wherever the ore is thinnest, it is generally richest, and the bottom part of the bed is of superior quality to the upper part. Several feet of the top part of the seam is often so poor in quality, that it is left unwrought in the mines. In some parts of this valley, also, the blackband becomes changed to a ferriferous limestone, known as the "Mountain ore."

There are several other horizons in the lower Coal Measures of the State, where the blackband ore is met in inviting appearance, one notable horizon being over the upper coal at Leetonia and Washingtonville. About six inches of shale usually separates the ore from the coal, and the ore itself is usually about six inches in thickness. This blackband was mined at the mines of the Cherry Valley Iron Company for some time after their two blast furnaces were built at Leetonia, but the ore was found to be too heavily charged with silica to be of value, and since 1872 it has been left unwrought in the mines. In the Hocking Valley district, the shale overlying Coal No. 5 sometimes also becomes a blackband, but, so far as observed, it is of too lean a quality to hope for good results.

Above the blackband ore in the Washingtonville Mines, there is a deposit of kidney ore, reaching three feet in thickness, and containing from forty to forty-five per cent of metallic iron. This ore was once mined in connection with the coal and blackband; but the cost of extraction reaching four dollars per ton, was too heavy to remove it, and since 1868 it has not been mined. An equally valuable supply of kidney ore is now delivered at the furnaces of this Company from the neighborhood of New Lisbon, at a greatly reduced cost.

The blackband iron-stone of Scotland, which has given such an impetus to the iron trade of that country, and made the names of Eglington, Glengarnock, Coltness, Gartsherrie, etc., familiar to iron founders in every quarter of the globe, is associated with the Coal Measures of the Scotch coal-field. The ore is mined in Lanarkshire, Fifeshire, Ayrshire, Linlithgowshire, and Stirlingshire, and is associated with a superior iron-making splint coal resembling the block coal of the Mahoning Valley. The splint coal is usually about eighty feet above* the horizon of the iron-stone, but neither of these strata are continuous over the area where they are due. Both seams are generally found in place, though sometimes the coal and sometimes the stone is wanting. The blackband appears never to be found where there are no trap-rocks, and it is the opinion of some of the Scotch geologists that the formation of blackband was due to the impregnation of the iron from the trap taken up by the vegetable and animal matter found in these strata.

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* On page 149 of my last annual report a clerical error in the manuscript made me locate the Scotch blackband "above" the splint coal, instead of *below* it.

The limestone ores—calcareous or argillaceous carbonates in their natural state, and hydra-peroxides or limonites when oxidized—are the most abundant iron ore deposits in the State. These ores are very numerous in the lower Coal Measures along their lines of exposure through the coal-fields, no less than twelve distinct horizons being found in the great vein region of the Hocking Valley and the Hanging Rock region. The limestone ores range in thickness from a few inches to three and four feet, locally swelling to seven and eight feet.

The Hanging Rock iron region—which includes the counties of Lawrence, Scioto, Jackson, and Vinton, in Ohio, and the counties of Greenup, Boyd, and Carter, in Kentucky—has long held a high rank as one of the finest iron-making regions in the United States. The cold blast iron made from the ores of this region is especially adapted to the manufacture of car wheels, ordnance, and other castings requiring an unusually tough and strong iron.

The main seam of ore of the Hanging Rock region ranges from six to sixteen inches in thickness, occasionally swelling in pockets to four and five feet. It rests on a stratum of limestone known in the geological reports as the ferriferous limestone. These strata underlie Coal No. 5. This coal sometimes comes down to within six or eight feet of the ore, and again rises up twenty to thirty feet above it. The ore is chiefly mined by stripping, as the crop ore, by reason of the oxidation of the original bed, is more valuable than the unchanged carbonite under the strong and firm cover of the hill. The horizon of this ore in the counties above named has been laid bare around nearly every hill, and the ore stripped for furnace use. Most of the furnaces of this region are charcoal furnaces; but within the past year or two, owing to the growing scarcity, and consequent increased value of wood, several of them have been changed to use stone coal, and all the new structures have been erected for the use of stone coal. There are two or more seams of coal in Jackson and Vinton counties in Ohio, as also the Coulton coal in Kentucky, adapted for smelting iron as the coal comes from the miner's pick.

Several of the other seams of the block and kidney ore are mined and used in connection with the limestone ore, but none of these seams are as valuable as the limestone bed. The kidney and block ores are also carbonates and limonites, but, as a rule, they are less rich in metallic iron, and more largely impregnated with silica than the limestone ore.

The following interesting description of the Kentucky division of the Hanging Rock region is copied from the Geological Report of Kentucky:

The Kentucky division of the Hanging Rock iron region at present embraces the whole or parts of Greenup, Boyd, Carter, and Lawrence counties. The ores are stratified carbonates and limonites, occurring in the lower Coal Measures, beginning with the ore just described, resting upon the sub-carboniferous limestone, and extending through six hundred to seven hundred feet of the Coal Measure strata. The ores are mineralogically similar, but differ somewhat in their physical character and circumstances of deposition. They are popularly known as limestone, block, and kidney ores. They usually occur at well-defined geological levels, but do not always form connected beds. They also differ in thickness, ranging from four to eight inches in some of the thinner beds, to fourteen feet in one local deposit. This latter is the Lambert ore of Carter county. The most common thickness is from six inches to one foot. There are from ten to twelve ore beds which are of more than local extent in this region. In addition, there are numerous local beds, one or more of which is found at nearly every furnace. This region supports eleven charcoal and two stonecoal furnaces.

The following analyses, by Dr. Peter and Mr. Talbutt, of the Kentucky Geological Survey, show the composition of some of the ores of each class in this region:

COMPOSITION.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Iron peroxide	67.890	71.680	54.530	68.928	61.344	66.200
Alumina	1.160	4.155	2.120	2.768	4.236	3.907
Manganese brown oxide	.980	.090	1.380	.290	....	.030
Lime carbonate	.120	.380	.040	.680	.750	.430
Magnesia	1.275	.050	1.823	.641	.208	.345
Phosphoric acid	.143	.084	.908	.249	.795	.130
Sulphuric acid	....	.270	.336	.748	.041	.182
Silica and insoluble silicates	15.560	12.650	28.360	15.240	21.480	16.530
Combined water	*12.903	10.800	10.900	11.100	11.200	11.730
Total	100.000	100.159	100.397	100.643	100.054	99.484
Metallic iron	47.501	50.176	38.171	48.249	42.941	46.340
Sulphur	....	.108	.134	.298	.016	.072
Phosphorus	.062	.036	.428	.098	.347	.057

No. 1. Lower limestone ore, Kenton furnace, Greenup county.
No. 2. Upper limestone ore, Graham Bank, near Willard, Carter county.
No. 3. Lower block ore, Kenton Furnace, Greenup county.
No. 4. Upper or main block ore, Laurel Furnace, Greenup county.
No. 5. Yellow kidney ore, Buena Vista Furnace, Boyd county.
No. 6. Yellow kidney ore, Mount Savage Furnace, Carter county.

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* And loss.

The Hanging Rock iron bears a reputation for excellence for general foundry purposes which is unsurpassed by any iron in the United States. The iron produced is mostly hot-blast charcoal iron, but some of the furnaces are worked with cold-blast for the production of car wheel iron. The reputation of the iron of this region is, however, chiefly founded upon its excellence for castings of all sorts. The iron combines, in a remarkable degree, great strength, with fluidity in casting and non-shrinkage on cooling. The stonecoal iron of this region is used almost entirely for the manufacture of bar iron and nails. The stonecoal iron is made from the ores of this region mixed with a considerable proportion of ore from other States. The fuel used is the celebrated Ashland or Coalton coal. It is a dry burning non-coking coal, which is used raw in the furnace, and is of such excellent quality that no admixture of coke with it in the furnaces is necessary, as is the case with most of the other non-coking furnace coals of the West. The charcoal iron is manufactured exclusively from the native ores, which yield, as shown by the books at a number of the furnaces, for periods ranging from one to four years, an average of between 31 and 32 per cent. of iron. The ores of the region are known as limestone, block, and kidney ores. These names are due to peculiarities of structure or position, rather than to any essential difference in chemical composition. As a rule, however, the limestone ores are the richest and most uniform in quality. The kidney ores are next in value. The block ores present greater variations in quality than any other, some of them being equal to the best of this region, and some so silicious and lean that they cannot be profitably worked

The first blast furnace erected in the State of Ohio was built on Brush Creek, in Adams county, in the year 1811. It was a cold-blast structure, and the machinery for blowing the cold air was driven by water-power. The product of the furnace was about one ton per day. The first furnace built in the Hanging Rock region occurred in the year 1815. It was located in Greenup county, Kentucky, and called the Argillite. This was followed by the erection, on the Ohio side of the river, of the Vesuvius, Hecla, Lawrence, Mt. Vernon, and others. These were all cold-blast furnaces, and the cold air, in some cases, was blown through hollow gum logs. In those early days there was little money in circulation, and the wages of the workmen were nearly always paid in store goods—a practice that still obtains at many of the charcoal furnaces of the region. The products of the furnaces were mainly cast into salt-kettles, coal-stoves, and other kitchen utensils. The first forges erected were run by water-power, and the iron was hammered, instead of being rolled into merchant bar.

The ores of the Hocking Valley district belong to the same family as those of the Hanging Rock region, and a number of the beds belong to the same geological horizon. They are known as limestone ores, block ores, kidney ores, nodular ores, etc., and are either carbonates or limonites, the limonites being carbonates oxidized by the action of the atmosphere. Beginning with the horizon of Coal No. 4, and reaching up to the tops of the highest hills, there are no less than ten to twelve different seams of ore. The most highly prized beds, so far as the mining developments have gone, are what is known as the Iron Point ore, and the Hanging Rock ore; the former lies from seventy-five to one hundred and thirty feet above the horizon of the "Great Vein" bed of coal, and the latter below Coal No. 5. The kidney ores used in the blast furnaces of the valley are limonites. They are usually quite thin, and are obtained by stripping; but the Iron Point ore, which ranges from six inches to five feet in thickness, is boldly followed into the hill, and mined in the same manner as the coal is won. A limonite on the outcrop, it becomes a carbonate under cover. In the Ironton region, as also in Jackson and Vinton counties, the carbonates usually contain more silica, sulphur, and other impurities, than the limonites, and though leaner ores, possess a denser structure. By reason of these imperfections, the furnace men of these regions can not produce as good a quality of foundry iron from the carbonates as from the limonites; but in the Hocking Valley no trouble has so far been experienced with the carbonates of the Iron Point Mine.

The first furnaces built in the Hocking Valley region were the Hocking Furnace, erected in the year 1851; the Logan Furnace, erected in 1853; and the Union Furnace, erected in 1855. They were all cold-blast charcoal furnaces; the ores used were the "block ores" of the valley. At that time it was the general opinion of furnace men that hot-blast pig-iron was not adapted for making bar iron, and more than half the blast furnaces in the State were using the cold-blast. The first geological survey of the State, in 1837 and 1838, pointed out several beds of iron ore in Athens, Perry, and Hocking counties, and the early reports of the second geological survey (1869 and 1870) also called attention to the existence of a number of ore horizons in these counties; but it was not until the beginning of the year 1876 that iron manufacturers became seriously interested in the iron resources of the Hocking Valley. Since that time this new iron region of Ohio has become the promised land to iron manufacturers, hardly a month passing that has not witnessed some of them in the district viewing the coal, ores, and limestones, and making purchases of valuable and extensive mining plants.

The first stone-coal furnace built in this region was erected by Mr. Samuel Baird, in 1875, three miles north of the village of Gore, in Hocking county. The ore, the coal, and the limestone were all in the same hill, and were each level free. The ore proved to be the equivalent of the ferriferous limestone ore of the Hanging Rock region, and to rival that famous iron-stone in richness and value. Pig-iron was made at a cost of $11 and $12 per ton, at a time when similar brands of iron could not be produced in any other district of the State at less than $17 to $19 per ton, and when more than one-half of the blast furnaces of the Union were idle, unable to run and clear expenses.

Both the Iron Point and Baird ores are limonites at the outcrop, usually of a reddish-brown appearance, but when followed in the hill they become carbonates, bluish-gray in color, and very compact in character. Both seams are very persistent as a whole, though liable to sudden changes in height, or to thinning out altogether over certain spaces The Baird ore is not as thick as the Iron Point deposit. The upper part of the Iron Point seam frequently changes to a blackband ore.

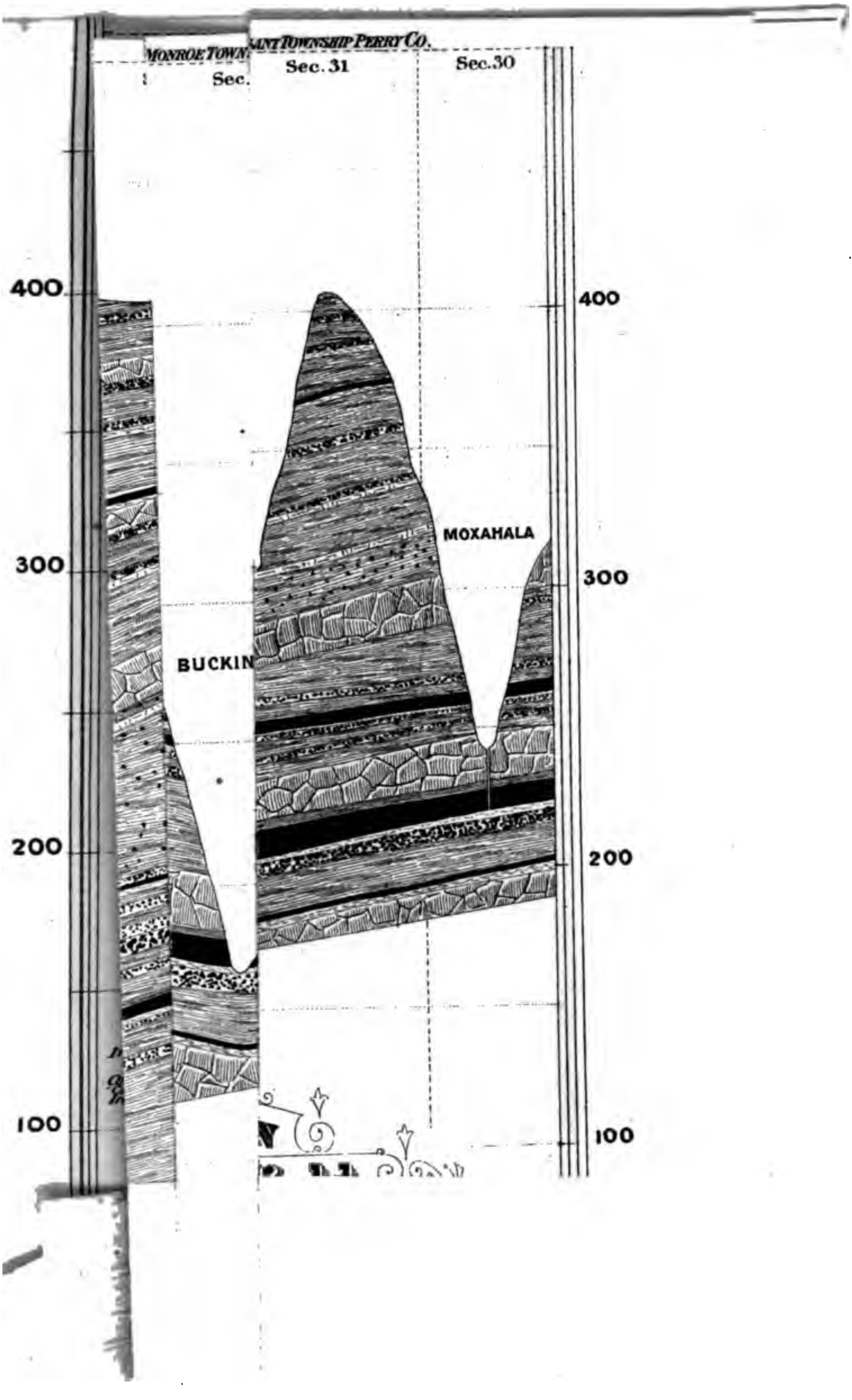
The Baird Furnace was followed by the location of two furnaces at Shawnee, the Fanny and the XX, and one at Gore, the Thomas Iron Company's. The Shawnee experiments were looked upon with a good deal of suspicion by the practical men of the valley, for although it was well known that iron could be made cheaper than in any other region of the State, the ore supply was believed to be very limited.

At the time the Shawnee furnaces were in course of construction, the coal trade was very dull, the mines not working half the time. The majority of the miners, experienced men from the coal and iron districts of Scotland, England, and Wales, were, during their leisure time, debating the question of the ore supply, and prospecting for ore on the mountain sides as passtime. Among the number there was an old miner named John Mason, a man with very little school education, and who knew nothing of geology as taught by the school men and expounded in the geological reports. With his pick in his hand he was out on the hillside, prospecting every leisure hour he could command, and at length laid bare a bed of ore fully four feet thick. Mason covered up his ore mine, marked the place with a fence rail, and offered to show the Fanny Furnace Company the mine for $400, or $100 for every foot of thickness of ore. His offer was refused, and the statement of the old miner was looked upon by the officers of the company as visionary and boasting folly. A subsequent examination of the property on which the ore bed was claimed to exist, however, revealed a compact, limonite deposit of ore in a horizontal layer, four feet in thickness. The hill on which the ore bed was found was named Iron Point.

The horizon of this ore bed is, as I have said, a few feet above Coal No. 7, known as the Bayley's Run coal in the geological reports. This is the same horizon as the blackband ore of the Tuscarawas Valley, at Port Washington, and other points, and it is undoubtedly the equivalent o the blackband of Tuscarawas county. Previous to the discovery of the Iron Point ore by John Mason, the same bed had already been opened by General Thomas Ewing, in the Lower Sunday Creek Valley, along the line of the proposed Atlantic and Lake Erie Railroad, showing a thickness of seam at the outcrop of five and six feet. Before these openings were made in this ore, the counties of Athens, Perry, and Hocking had been reported upon by Prof. E. B. Andrews, of the geological survey.

Since the completion of the Baird Furnace, and the discovery of the Iron Point ore, the "new iron region of Ohio" has become the scene of unusual activity, and the theme of numerous descriptions. Fourteen blast furnaces will be completed and in blast by the beginning of January of next year. Nine of the series are now in blast, and a new one is no sooner completed than another is projected. Should the hopes of furnace men be realized, of which there is no good reason for doubt, there will be at least fifty furnaces in operation in this district before the close of the present century.

The State geological survey has been also resumed in this district, owing to the importance the district has assumed, and a great deal of new and valuable information has been brought to light since the publication of the reports of progress in 1870. The following sections, compiled from material gathered by the geological survey, throw valuable light on the structure and resources of the Hocking Valley region:


MONROE TOWN
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THE NEW

LIMESTONES.

The beds of limestone and iron ore associated with the coal seams of the State are numerous and valuable. In the Lower Coal Measures at least a dozen different seams of limestone are known. Some of them, like the coals, are local deposits, and others are of very extended depositure. The Maxwell Limestone, the lowest of the series, is supposed to be located on the base of the Coal Measures. It is not a continuous bed, and is mainly found in the south-western part of the coal-field. Coals No. 3 and No. 4 are nearly always covered with limestone beds ranging in thickness from one to fourteen feet, the limestones in turn capped with bands of iron ore from a few inches to two feet thick. The limestones are more persistent than the seams of coal with which they are associated, and serve as guides to mark the horizon of Coals Nos. 3 and 4, when these seams are wanting. There is sometimes a seam of limestone a few feet below Coal No. 3; also, a seam ten to thirty feet above the limestone which caps Coal No. 4. This upper seam, in Coshocton county, lies in three benches, and aggregates six feet in thickness. It is black and noble-looking, resembling black marble, and has been quarried and shipped to market under the impression that it was black marble. Neither of these limestones are as persistent as the ferriferous beds which form the cover of Coals No. 3 and No. 4.

At Washingtonville and Leetonia Coals Nos. 3 and 4 rest on beds of limestone, and at Salineville the two coals in course of development, Nos. 6 and 7, also have limestone beds below them, though that below No. 6 frequently changes to sandstone. In the Hocking Valley region there is sometimes a thin bed of limestone below Coal No. 6 (the Great Vein), occasionally another thin seam below Coal No. 6*a*, and a persistent seam below Coal No. 7. In the barren measures there are two well-known limestones, known in the Geological Reports as the Cambridge and Ames Limestones. As we approach the Pittsburgh coal in ascending order, other series of limestones are occasionally met. In the Bellaire region the strata between the different seams of coal, above the Pittsburgh bed, are often one mass of limestone from top to bottom.

In my last annual report I pointed out the true horizon of the ferriferous limestone of Southern Ohio, showing that it underlies Coal No. 5 instead of overlying Coal No. 6, as given in the Geological Reports of the

State. None of the members of the Geological Corps were disposed to credit the facts in this regard, but a recent re-survey of the southern portion of the Ohio coal-field has settled the question. The ferriferous limestone of Ohio and the ferriferous limestone of Pennsylvania are, in my judgment, equivalent strata. The Pennsylvania geologists locate the ferriferous limestone of that State above Coal No. 3, but they also locate Coal No. 1 below the conglomerate rock, and regard this seam as a sub-carboniferous coal. While it underlies the horizon of the conglomerate, it is, notwithstanding, a true coal, having been deposited in troughs or basins scooped out of the conglomerate rock and the upper surface of the Waverly Sandstone. So long as the Ohio geologists placed the Ohio ferriferous limestone above the horizon of Coal No. 6, and the Pennsylvania geologists regarded the Sharon coal as a sub-carboniferous seam, it was simply impossible to reconcile the theory that the ferriferous limestone of Ohio and Pennsylvania were equivalent beds; but when it is settled that the true place of the Ohio ferriferous limestone lies between Coals Nos. 4 and 5, and the Sharon coal is No. 1 of the Pennsylvania series, there can be no difference of opinion on this question.

MINING SCHOOL.

One of the most important acts of the General Assembly of last winter was the enactment of the law making provision for a mining department in the State Agricultural and Mechanical College. Mining and agriculture are the two great industries of modern civilization. The mistakes of agriculture in impoverishing the soil can easily be remedied, while the mistakes of mining, resulting in the loss or waste of our mineral treasures, can never be recalled. There can be no renewal, no reproduction there, for, as an English mining writer puts it, "We are drawing, more and more, upon a capital which yields no annual interest, but once turned to light, and heat, and force, is gone forever into space." The Legislature would do well to follow up its action of last winter in providing for the creation and maintenance of a State School of Mines, to be located in the heart of one of the principal mining districts, for example, at Youngstown, in the Mahoning Valley, or some point in the Hocking Valley, or at Ironton, on the Ohio River. More money is lost, and mineral treasure wasted in this State each year by bad practice than would suffice to erect and equip a first-class mining school.

It is not easy to overestimate the advantages which would result to the State from the establishment of a State School of Mines, located in the the heart of one of the important mining and iron manufacturing regions. Our miners of coal, and manufacturers of iron are among the most practical and energetic of their class in the world, but in nine cases out of ten they are practical men only, without scientific training. One of the best practical miners and iron manufacturers in the State, having worked his way from the puddler's forge to his present position, on my introducing two young students of mining engineering, from the State Agricultural and Mechanical College, who were about to commence work in the mines with the object of acquiring a practical knowledge of the business, remarked that if he had possessed a practical knowledge of chemistry in his younger years, it would have been worth a million dollars to him. And this is the life experience of the great majority of operators of mines and iron works. Such men, in calling to their assistance the schoolmen, that is, the graduates of academies of science, learned in the theory of mining and the manufacture of iron, but practically unacquainted with a single problem of the mine, the blast-furnace, and the forge, have too frequently been imposed upon, and have come to look with contempt upon mere theorists. Theory and practice, to be of any avail, must be acquired by one person—blended together. We must take the practical man and make him a practical-scientific man, to obtain the best results.

The nations of Europe long ago learned the natural advantage of providing scientific mining education. Even during the disturbed and upturned period of the French revolution, the attention of the government of France was earnestly directed to mining education, and the Council of Mines, organized at that time on the recommendation of Founeroy, produced such valuable results that every government of France, whether despotic, limited monarchy, or republican, has since given attention to this subject. In the mining schools of France the students are taught at the expense of the government, the only conditions of admittance being that the pupils must be between the ages of fifteen and twenty-five years. The subjects taught are geology, mineralogy, the assaying of minerals, mathematics, mechanics, engineering, etc. In addition to the higher mining academies, schools for master miners are established in every mining region, and all mine superintendents or bosses are required to graduate at these schools, and receive a certificate of competency previous to assuming charge of mines. None but practical miners can be admitted to the schools for master miners. Mine book-keeping, mine surveying, geology, mineralogy, and chemistry are the subjects taught.

Germany has, for centuries, stood in the first rank among the nations of the earth by reason of the excellence of her mining schools. The Frieburg School of Mines Institute, situate in the heart of the lead and silver mines of Saxony; the Claudstel School of Mines, located in the Hartz mountains, and the Royal School of Mines, of Berlin, have trained some of the ablest mining engineers of the world, and have earned for Germany the title of the School of the World in the art of mining. As in France, schools for master miners are established in every mining district, and all mine bosses must be graduates of such schools to fit themselves for these responsible situations.

Scientific mining education in Great Britain was, until the middle of the present century, almost wholly neglected, receiving no encouragement from government, and very little from individuals. As a result, the French and German mining engineers were far in advance of those of Britain, and with the exception of the discovery of the safety-lamp, by Davy, all the important discoveries in mining engineering science, before the beginning of the latter half of the nineteenth century, came from the continent of Europe. The following extract, taken from the report of the South Shields committee, appointed in the year 1842, to investigate the causes of accidents in coal mines, shows the status of the scientific attainments of the officers of British mines at that time:

> The professions, the arts, the manufactures, and every interest of Britain, possess the great advantage of science in daily and intimate connection with all their branches and details, except those paramount to her prosperity, the mining interest, which seems almost beyond the reach of her investigations, placed in the hands of those whose early years, spent in the darkness of the mine, afford small opportunity of acquiring her enlightening and advancing principles. Consequently, the system of mining in this country opens up a vast field, naturally and individually, for the beneficent application of science, and requires only to be brought into familiar intercourse with her to elicit the most valuable results.
>
> The committee are deeply impressed with the great advantages derivable both to humanity and the mineral wealth of the kingdom, for the bringing to bear the lights of science upon this subject yet so imperfectly developed. This may be stated without derogation to the great, practical talent of the men that are the present guides and directors of the mines, several of whom, it is gratifying to know, are convinced of the necessity of the introduction among their officers of a more liberal system of scientific education. Turning a stream of science into the British mines, the committee are aware, also militates against the prejudices of some other practical miners, who conceive it might prove injurious by destroying a class of most meritorious men, whose experience, from almost infancy, is indispensable to their advantageous working, and for whom the substitution of even scientific and learned theorists, they conceive would be a very unbeneficial compensation. The object is not to deprive the mines of such experience, but to add to experience knowledge; to sustain or correct it by the enlightened principles of science.
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> The occasional visits that science has already paid to the mines have been productive of the most striking effects. M. Jars, the French academician, as early as 1768, after a few visits to the mines, in a memoir read to the Royal Academy of Paris, laid down the principles for their correct ventilation that are at this day the great guides of British miners. Sir Humphrey Davy, by one examination of a single mine, was led into a course of experiments that terminated in the safety lamp, and Prof. Bischof, of Bon, by his minute analysis of the inflammable gases of the German mines, has been able to detect in them a considerable quantity of bicarburetted hydrogen (olifant gas), which, from its explosibility at a low temperature, is of vast practical importance in the employment of safety lamps. How little the mines have the benefit of such knowledge at the present time, with the exception of a very few honorable instances among their directors, any one acquainted with their practical working must at once admit.
>
> In their daily application of the great modern-discovered power with the most gigantic engines of Britain, they are ignorant of steam, mechanics and mathematics; opposed, and sometimes defeated, by the pressure of water, they know nothing of hydrostatics or hydraulics; their profession consisting of the extraction of minerals, they are unacquainted with mineralogy, metallurgy, or geology; existing by the correct operation of currents of air, they scarce have heard of pneumatics; and standing within the range of a vast laboratory of nature, whose operations are daily producing death, they still continue ignorant of chemistry.

The South Shield's committee earnestly recommended that the higher officers of mines should be required to possess a sufficient knowledge of mathematics and practical surveying, mechanics, hydrostatics and hydraulics, pneumatics, chemistry, mineralogy, metallurgy and geology; and also recommended the supervision of mines by Parliament, and a well organized system of government inspection for the proper security of the lives and health of miners. In 1850 a law was enacted providing for government inspection of mines, and for the appointment of competent practical mining engineers as mine inspectors; and in the year 1852 a society, called the North of England Institute of Mining Engineers, composed of the best talent in the United Kingdom, was organized for the purpose of meeting at stated intervals, and reading papers on the working and ventilation of mines. The annual reports of the mine inspectors, and of the North of England Institute of Mining Engineers, are among the most valuable contributions to mining literature in the English language. In the Royal School of Mines provision has been made, within the past few years, for the education of master miners, upon reasonable terms, the course of instruction extending over three years. The mode of instruction is by systematic courses of lectures, by written or oral examinations, by practical teaching in the laboratory and drawing-office, and by field practice. During the first two years, the subjects taught embrace inorganic chemistry, mechanical drawing, physics, applied mechanics, and mineralogy. In the third year, mining, essaying, and geology are taught in the mining department; metallurgy and laboratory practice in the metallurgical department; and natural history, with laboratory practice; geology and palæntology in the geological department. In the third year the students are allowed to select such subjects of study as bear directly upon their particular profession. A course of lectures is also delivered, annually, at a nominal admission fee, to working-men. These lectures, which were commenced in the year 1851, created such an interest, and the attendance upon them was so large, that in the following year the officers of the School of Mines voluntarily increased their labors in this field, thus providing the working-men with an average of twenty-four, instead of six, lectures each year.

In the year 1856 the Bristol School of Mines was established, and has taken high rank as one of the best mining engineering schools in Europe. The subjects taught are of a practical scientific character, a full course of instruction extending over a period of two years, though students are admitted who desire to complete their studies in one year. The laboratory of this school is open one day in each week to all students, whether they belong to the school or not, who desire to study practical chemistry, assaying, and analysis. In this school there is also a school of applied science for boys, which affords a suitable preparation for the laboratory.

There are also numerous schools for master miners, most of which are located in the heart of the mining regions of the United Kingdom. These schools were in many cases founded by mine owners. Since the passage of the mines inspection act of 1872, which requires all underground managers to appear before a board of examiners, pass a satisfactory examination, and receive a certificate of competency, the schools for master miners have rapidly increased in number, such schools being now found in almost every mining village. Twenty five years ago not more than thirty per cent. of the mine bosses of England and Wales could write their own names. Now all is changed. All mine bosses can not only read and write, but before assuming charge of mines are examined on questions of mine book-keeping, mine surveying, and on questions of chemistry and physics. All applicants appearing before the board are very rigidly examined, and certificates are withheld in all cases where the applicants fail to show an approved knowledge of the mechanics of mine ventilation and the various modes of winning coal, and also a knowledge of hydrostatics, hydraulics, pneumatics, etc., so far as these sciences affect the ventilation of mines and the security of the health and safety of the miners.

A number of the more intelligent colliery managers of Great Britain have recently proposed the establishment of a National Society of Colliery Managers, for the purpose of increasing the status of the profession, and providing for the sick and infirm, and for the families of deceased members. The nature and objects of such an association are set forth in the following propositions:

1. The erection and support of some college or colleges at which students might be especially trained for the profession, and into which the members' sons might be admitted free or at a nominal charge.
2. The mutual improvement and assistance of each other in the knowledge required for overcoming the ever increasing difficulties of mining, by the distribution of books and papers on mining; by each member contributing in the form of papers their opinions and experience on, and in connection with, difficult questions; by the members imparting to each other the methods and appliances in vogue in their respective districts; by having a branch society formed in each district through which its members might meet and converse on the state of trade, and generally to assist each other; and by having all these branches amalgamated in one grand national federation, so that the opinions of the whole of the colliery managers in the kingdom might be had on any question without much trouble.
3. The advancement of the position of the profession in all worthy directions.
4. The protection of the positions and characters of the members against injustice, by causing proceedings against any member to be watched on his behalf, and to assist him in vindicating his character, if possible, when he would otherwise be unable to do so for want of funds.

5. Their relief in case of accident or sickness, and the relief and support of their widows and orphans in case of their being unprovided for at death.

These objects lay open a wide field for the operations of a society, and their achievement might well engage the attention of every colliery manager and well-wisher of the profession. While the society would be of great advantage to managers, it would be so to coal owners as well, as by this imparting of knowledge one to another, knowledge would gradually become more equally diffused. Not that it would be taken from one member and given to another, until all were alike in knowledge and ignorance, but the very effort of one imparting knowledge to another would enable him to see in a clearer light himself, and give him an opportunity of feeling his own shortcomings and ignorance. We would not have a few clever managers, and a great number of dull ones, but we would soon have a large number of clever ones, and a few cleverer still. The former would receive the ideas and methods of thinking out questions of the latter, and if they remained dull long it would be pretty much their own fault.

The mines of Ohio, which are free from the terrible scourge of fire-damp, are not as immediately dangerous to human life as British mines; but the necessity of educated and certificated mine bosses in this State, as, indeed, in every State of the Union, is none the less urgent in consequence. The State, the mine owner, and the miner, would each be benefited by increased intelligence on the part of the responsible managers of mines—the State, in the greater acreage of coal recovered; the mine owner, in the reduced cost of extracting the coal; and the miner, in the improved safety and salubrity of his working place. So far as the developments of our mines have progressed, a ton of coal has been lost to posterity for every ton recovered.

The mine owner is also a loser; though, as coal property is abundant and cheap in most of the mining regions, he does not care, so long as the immediate cost of recovering the coal is not increased. But when bad practice prevails in mining, resulting in the useless waste of coal, the cost of mining is surely, directly as well as indirectly, increased. And this is equally true, where defective ventilation prevails; for, where the miner has not pure air, he cannot do the same amount of work, and when he becomes worked down, he is ready for a strike, and cannot be reasoned out of the necessity for one.

Pennsylvania has made the first movement looking to increased intelligence among practical miners, in the provisions of the mining law in regard to the qualifications of the mine inspectors. The following questions were prepared by the board of examiners, for the examination of applicants who desired the appointment of Inspector of Mines of the bituminous regions of Pennsylvania, under the act of April 18, 1877. Forty applicants, consisting of working miners, and mine bosses, were examined, sixteen of whom passed the board, the highest standing ninety-seven, and the lowest sixty-eight:

What is your age?

Are you a citizen of the United States?

What is your present occupation; and how long have you been thus engaged?

Have you had five years' experience in the workings of the bituminous coal mines of Pennsylvania?

State particularly what opportunities you have had for obtaining a practical knowledge of the workings of mines?

Have you had any experience in mines where fire-damp, or any noxious gases have been evolved to any great extent?

How would you lay out a mine to conform with the provisions of the "ventilation act?"

What are the most frequent causes of accidents in coal mines?

Where should the largest pillars be left, in swamps, or on summits?

In the use of powder, where there is fire-damp, what plan do you consider the safest?

What effect, if any, does gob, heaped against the side of a pillar, have on its strength?

Which requires the largest pillars, thick or thin seams of coal—all other conditions being the same?

How would you test the safety of the roof in entries and rooms?

What kind of wood, in practical mining, do you consider the best for pit posts?

Name the different gases found in coal mines.

What is the composition and relative weight of carbonic acid gas (black-damp), as found in coal mines; and how can its presence be detected?

What percentage of carbonic acid gas, in the air of a mine, will extinguish the flame of a lamp; and what percentage is dangerous to life?

Mention some of the causes which produce carbonic acid gas in mines.

What is the composition and relative weight of carbureted hydrogen gas (fire-damp), as found in coal mines; and how can its presence be detected?

How is this gas produced, and where is it found in mines?

What is the appearance of the flame of the lamp or candle, when the mixture of this gas and air is near the explosive point?

Will this gas explode, unmixed with air?

After explosion, is this gas dangerous to life; and is it heavier or lighter than air? What is it called, after explosion?

What are the component parts of atmospheric air, and the proportions?

What is the weight, or pressure, of the atmosphere at the earth's surface, nearly?

What safety-lamps do you consider the best?

Give a general description of each of these lamps, and how used.

How many holes, to the square inch, in the gauze surrounding a lamp, is considered safe?

What is the reason that the gas, when ignited in the lamp, does not pass through the gauze, and ignite the gas outside the lamp?

If the gauze is red hot, will it ignite the gas outside the lamp?

What velocity of air-current will drive the flame through the gauze?

If you were examining a mine, and the gas in your safety-lamp should ig would be your method of procedure?

Mention the different modes in use for the ventilation of mine

Can natural ventilation be relied upon, at all times? If why?

Name some of the best modes of artificial ventilation.

Explain the principles of furnace ventilation.

Does the capacity of a furnace depend upon the depth of the shaft, to secure the same ventilation?

Where would you locate a furnace, to be the most effective?

Where would you locate the upcast—in low, or elevated positions?

What advantage, if any, is there in building a chimney on the surface, at the upcast shaft?

What is the best form of shaft, or chimney, for ventilating purposes?

Can you, with safety, use a furnace to ventilate mines, where explosive gases are generated? If so, describe the kind you would use.

How would you kindle a furnace, situated at the highest opening, when the exterior air is at the temperature of 90°, and that of the mine at 50°, and the current moving in the direction of the lowest opening, to prevent filling the mine with smoke?

How does the steam-jet compare with the furnace, as a means of ventilation; and how should it be applied?

Describe the different modes of using the fan in ventilating mines. Which mode would you prefer; and why?

If you wish to double the velocity of the air-current in the mine, in what proportion would you increase the capacity of the furnace, fan, or other motive power?

If you consider it of any advantage to split the air-current in mines, state your reasons, and the method of doing the same.

What will be the volume of air, per minute, passing through an opening six feet nine inches by five feet, when the anemometer shows a velocity of 105 feet per minute?

What instruments should an inspector have, to enable him to discharge his duties under act; and what is the particular use of each instrument?

How does a barometer indicate danger in a mine?

What means may be employed to ascertain the velocity of air-currents in mines, other than by the anemometer?

What is the cubical contents of a circular shaft, whose diameter is six feet, and height sixty feet?

Give a description of an approved safety-catch, and its action.

What test would you give to wire ropes, and chain cables, used in shafts and slopes?

In a mine having two divisions, from the down-cast to the upcast, one division being 3,000 yards long, on which is placed a regulator, three feet high and four feet wide, what should be the width of a regulator, of the same height, placed on the other division, which is 4,000 yards long, so that the same quantity of air may pass through both openings, other conditions being the same in both divisions? What the dimensions of a square regulator, on the latter division, to allow the same quantity of air to pass?

MINERS' BENEFIT FUNDS.

I have in former reports recommended, and again take occasion to point out, the necessity and advantages of establishing benefit funds at the mines for the purpose of aiding the crippled and the infirm, the widow and the orphan. This is a movement in which the operators of the mines could lead, and such action would beget confidence, as well as be the means of doing a vast amount of good. A miner brought up to work in the mines from boyhood is, in nine cases out of ten, unfitted afterwards for any other occupation, and hence the common expression, "once a miner, always a miner." A few cents per month, set aside as a benefit fund on the part of employés and employers alike, would feed and clothe the widow and fatherless children, whose mainstay of support has been killed in the mines, until they are able to provide for themselves, and support the family of him whose bones have been crushed or broken by accident until he becomes strong enough again to renew his daily labor in the pit.

The Philadelphia and Reading Coal and Iron Company, of Pennsylvania, has, since the occurrence of the Avondale catástrophe, had such a fund at the mines. The following proposition has been made to the employés of this company during the present year:

To the Miners and Laborers of the Philadelphia and Reading Coal and Iron Company:

The Philadelphia and Reading Coal and Iron Company will give twenty thousand dollars ($20,000) as an endowment of a beneficial fund for insurance against accidents and death of such of their miners and laborers as may desire to accept its benefits, by complying with the following provisions:

First. Miners and inside laborers to pay to the fund thirty cents per month.

Second. Outside laborers to pay twenty cents per month.

Third. Boys and old men to pay either five or ten cents per month, as may be determined by the proper district superintendents.

All payments to be made monthly by deductions from the pay-roll; but no payments to be made in any month in which the person paying does not work, and in cases where not more than one week's time is made in any month, the payments for said month to be reduced one-half.

In case of any accidental injury sustained by a contributor, when actually engaged in the employment of the company, which incapacitates him from work, the party injured shall receive, during the period of such incapacity, the following sums:

Those who have paid thirty cents, or twenty cents per month, shall recei
lars per week.

Those who have paid ten cents per month shall receive two dollar

Those who have paid five cents per month shall receive one doll

Provided that no payment shall be made for a longer period than six months, and that the certificate of a reputable physician that the disability is the result of an accidental injury, such as above described, shall be furnished at the end of each month.

In case of death directly resulting from any such accidental injury, the following sums will be paid:

On account of those who have contributed thirty or twenty cents per month, thirty dollars *in cash*, and seven dollars per week for one year; for those who have contributed ten cents per month, the sum of thirty dollars in cash, and two dollars and eighty cents per week for one year; and for those who have contributed five cents per month, the sum of thirty dollars in cash, and one dollar and forty cents per week for one year.

The said payments of thirty dollars to be made within one month after the death, and the weekly allowances to be paid monthly during the year, and in all cases a certificate of the coroner, or of a reputable physician, will be required that death resulted directly from an accidental injury sustained as aforesaid, and not from disease. It being provided that in case of death the payments shall be made exclusively to such relative, relatives, heirs at law of the deceased as are first named in the following list:

First—To the widow.

Second—To the children.

Third—To the parents.

Fourth—To the brothers and sisters.

Fifth—To other heirs at law.

In no case shall the money be applicable to the debts of the deceased, or liable to be attached by his creditors, and in all cases the decision of the trustees, either as the liability of the fund, or as to the proper recipient of its bounty, shall be final and conclusive upon all parties.

Those of the employés of the Company desiring to avail themselves of the benefits of this beneficial fund, must signify their wish by signing a book to be provided for that purpose, at the office of each colliery and iron-ore mine of the Company. Each will be left free to contribute or not, as he may desire; but in no event will any money be paid out of the fund to any other than a contributor.

The twenty thousand dollars endowment, and all moneys received from contributors, will be placed in the charge of Hon. Cyrus L. Pershing, President Judge of Schuylkill county, C. H. Tyson, President of the Safe Deposit Bank of Pottsville, and Franklin B. Gowen, President of the Philadelphia and Reading Coal and Iron Company, as trustees, who will make a public yearly statement of the receipts and expenditures; and any vacancy in the Board of Trustees will be filled by an appointment to be made by the President, for the time being, of the Philadelphia and Reading Coal and Iron Company.

All clerical expenses connected with the collection and payment of money on account of the fund will be borne by the company.

FRANKLIN B. GOWEN, *President*.

PHILADELPHIA, *March* 17, 1877.

RECOMMENDATIONS.

During the past two years it has been frequently urged that the duties of the Mine Inspector should be greatly enlarged; that he should be required to collect and publish an annual statement of the mineral statistics and resources of the State; that he should be empowered to act as umpire or arbiter in wages disputes between the miners and their employers, and assist in the settlement of all strikes; and that he should report upon all special grievances of miners in regard to low wages, truck-store pay, etc.; and several of these views have found expression in bills introduced in the General Assembly. The mining law was enacted for the sole purpose of protecting the lives and safety of miners; and in attending to his legitimate duty, the Mine Inspector has all the work, and more, than he can do. Besides, there are other officials specially charged with the duties named above. The Geological Survey, several volumes of the report of which are yet to be published, has charge of the mineral resources of the State; the statistical department connected with the Secretary of State's office has charge of the mineral stastatistics; the Bureau of Labor Statistics has charge of the industrial classes; and no umpire forced upon strikers could ever settle any wages dispute or other grievance. The new duties sought to be added to the Mine Inspector's office have been opposed by miners and mine owners alike, as foreign to the objects of the mining law.

The experience of other nations, and of other States of this nation, shows that it is neither wise, nor expedient, nor possible, to combine the duties of a mine inspector with those of other State officials, and make the mining law of any practical benefit to the parties for whose protection the law was enacted. The Mine Inspector must be an expert; he must be free and untrammeled in his action by other State officers who know nothing of mines, their dangers and means of safety. In England there are twenty-four Mine Inspectors, whose sole duties consist in seeing the law, providing for the protection of the lives
miners, enforced and obeyed. In Pennsylvania there are
six for the anthracite mines and three for the bitumi
with the enforcement of the mining law. In M

State Mine Inspector for thirty-three mines, located in one county. All these officials are practical miners, controlled by no other State official. In England the Inspectors are responsible alone to the Home Secretary. In other States of this Union, equally with our own, the Inspectors are responsible only to the Governor of the State.

The term of office of a Mine Inspector in this State is four years, and it should not be for a less period. The work of inspection is so various and multitudinous that at least two years of active work are required to become practically acquainted with the condition of the mines. In Great Britain the Inspectors are appointed for life, or during good behavior. In Pennsylvania the term of office is five years. None but mining experts—men trained to underground life from boyhood, and familiar with the modes of mining and ventilation—have ever been selected to fill the office of Mine Inspector, either in this or any other mining country. A person practically unacquainted with the gloom and danger of a coal mine, instead of being able to point out danger and propose means of safety during a visit to a mine, has to be taken care of by some of the miners, or he would lose himself in some of its labyrinthian passages, and never find his way out.

There are nearly three hundred coal mines in the State, extending over an area of 10,000 square miles, which come under the requirements of the statute. It is impossible to visit and inspect each of these mines more than once in each year, were the Inspector employed at this work alone, but with his office duties to perform he can not do it in less than two years. Several important sections of the law provide no penalties for violation of their provisions. These sections are not only a dead letter, but they stand in the way of a willing compliance with the provisions of the law in other regards. Such sections are important parts of the law, and ought to be made of some binding force, or otherwise be wiped off the statute books.

The remedy of injunction prevents a mine from working more than ten miners at once, whenever the law is violated as to ventilation, or in some other regards. A mine may have proper ventilation in two-thirds of its working places, yet the force of the mine may be reduced to ten men, and all the properly ventilated places stopped until the bad places are improved.

Penalties, by fine or imprisonment, or both, should be attached for neglect or refusal to provide and maintain the amount of air required by the statute, and the remedy of injunction should only be applied in cases of sudden and immediate danger, as where a mine has but one opening, or is liable to inundation of water, or explosion of fire-damp, etc. Enjoining a mine because bad air prevails in any of the working places, punishes the innocent and necessitous miner more than the guilty owner or agent of the mine. This is especially the case during times of low wages and half work, and knowing that complaint against a mine by the Inspector will, if proved, result in throwing the miners out of work, the workmen are most averse to testifying in court, or even of complaining to the Inspector.

The law requires that in all mines generating fire-damp, all the air-doors shall be so hung and adjusted that they will shut of their own accord, and can not stand open; and the agents of such mines are required to measure the amount of air in circulation at least once a month, and forward the result of such measurement to the Inspector. But there is no penalty attached for neglect or refusal All the mines in the State, whether they generate fire-damp or any other mineral gas, should have a requirement of this kind, with proper penalties attached. This would do much toward a proper compliance with the law as to ventilation—the most important, and at the same time the most difficult of enforcement on the part of the Mine Inspector, of any provision of the law.

The requirements of the law in regard to the distribution of the air of mines, need amendments. The column of air in circulation—one hundred cubic feet per minute per person employed in the mine—the statute says "shall be circulated to the face of each and every working place throughout the entire mine." This is neither necessary nor possible in working mines by pillar or room practice, because the rooms and entries alike must be drawn ahead of the current in the formation of the pillars of the mine. No pillar, however, requires to be more than one hundred feet in length. If a vigorous current of air is kept flowing through a mine along the windways, such as the law calls for, every room and entry may be advanced one hundred feet with safety, but farther than this is unnecessary, and ought not to be allowed. As new break-throughs or air-courses are made, the older ones should be promptly closed up, so that the air may be made to play as near the working places of the miners as practicable.

The air-ways of mines—especially the return air-ways—are, in a great many mines, too small to discharge the column of air required by the statute, unless costly and unnecessary ventilating power is applied. No air-way, whether intake or return, should be of less sectional area than thirty feet.

The traveling ways in slopes are, in many cases, unfit for men to pass up and down. In slopes where the miners can start up ahead of the train, and pass out at the mouth of the slope before the cars, a traveling way is of little consequence; but where the workmen have to travel behind the loaded train, and meet the return empty one before getting out, there should be a traveling way provided alongside of the slope at least two feet wide, and also man-holes cut every fifty feet, in which the traveler could find refuge. It is wonderful that so few accidents occur on slopes where no traveling way is provided.

The galleries of mines, along which the miners pass to their working places in the morning and return to day in the evening, are frequently so narrow that there is not room between the pillar and the track for a man to stand as the cars are passing to and fro. In the mines of the Ohio River, in the Bellaire district, opened on the Pittsburgh vein, this is specially true, owing to the fragile roof forbidding the cutting of wide entries. In some other districts besides Bellaire this condition of the main gallery and other traveling ways of mines is also met, and not a few accidents annually occur by men being crushed between the cars and pillars of the mine. Man-holes should be cut on all traveling roads of mines every fifty yards or less, in which at least three men could take refuge in all cases where there is not room for travelers to pass the moving train. Some traveling roads of mines also are frequently in a dangerous condition from the falling of the roof, as in the Pomeroy and other districts. The roof shale rapidly undergoes decomposition by exposure to the moving currents of air, and is frequently falling in fragments. In all such mines it should be made the daily duty of the boss and his assistants to inspect the roof, and take down all dangerous stones before any of the miners are allowed to enter the mine.

The law requires owners of mines to forward to the Inspector, once every four months, a statement or plan of the progress of the mine excavations up to date, to enable the Mine Inspector to extend the original map or plan of the mine. This provision of the act is not, and can not, be complied with, unless there were two or three mining clerks or surveyors in this office, doing nothing but extending maps of mines. There is, however, no occasion for furnishing plans of the progress of the mine workings oftener than once in each year, unless the Inspector should desire an addition in some special case. A penalty ought to be attached for neglect or refusal to furnish extensions. The law authorizes the Mine Inspector, if the plan of the progress of the mine excavations is not furnished within two months after the time designated, to cause an accurate map or plan of the whole mine to be made at the expense of the operator thereof, but no competent, practical mining surveyor cares to survey a mine against the consent of the owner. In every case where I have sought to employ mining surveyors under such circumstances, they have refused to do the work.

There is no penalty attached to the law for refusal to allow a check-weighmaster access to the scales to see the coal of a mine fairly weighed. Some companies offer no objections to check-weighmasters, but many others refuse them access to the scales, and order them off the premises, and the miners have no remedy but to strike.

To compel obedience to the provisions of the law to which the remedy of injunction applies, it is necessary to employ an attorney; and as suits are quite frequent under the law, the money paid for the services of attorneys could be saved to the State, if it were made the duty of the prosecuting attorney of the county in which a mine complained against is situated, to institute the necessary proceedings to enforce the provisions of the act, or to prevent or punish the violation of any of its provisions.

When a mine is approaching the abandoned workings of an adjoining mine filled with water or noxious gas, bore-holes ought to be kept four or five yards in advance, in order to prevent breaking into old workings suddenly, and thus endangering the lives and safety of the whole underground population.

CASUALTIES.

List of Persons Seriously Injured during the Year ending November 14, 1877.

November 22. Saml. Little, Franklin Mine: badly hurt.

November 30. Henry Wilson: fell under pump and badly hurt.

November 30. A. Shultz, Cramer Bank, in Trumbull county: badly hurt by fall of rock.

January 26. Laurel Dunlap, Todd & Wells' Shaft: fell under tipple; hurt in head and body.

January 29. Robt. Betts, Troy Mine: crushed between cars.

January 31. Chas. Pamley, Kyle Bank: explosion of fire-damp.

January 31. David Edwards, Kyle Bank: explosion of fire-damp.

January 31. Ben. Morgan, McKinney Bank: hurt by fall of slate.

January 31. —— Brandt, Brooks' Mine, Nelsonville: run over by cars.

February 1. Patrick Martin and Chas. Applegate, Grafton Mine: hurt by fall of roof.

February 14. Barney Clark, Grove Coal Company: fell down shaft; arm broken and shoulder-blade fractured.

March 1. Edward Cragan, Coalburg: hurt by explosion of fire-damp.

March 2. Jas. Davis, Coöperative Mine, Nelsonville: run over by car; leg amputated.

March 15. Geo. Hall, Coalport Mines: struck with a pick.

March 17. Wm. Boman, Pen Twyn: back broken by fall of roof.

April 1. David Edward, badly hurt in Peacock Mine, Pomeroy.

April 16. Jas. A. Kelley, Poston's Mine: leg broken and hurt on head.

May 1. Harvey Cox, Poston's Mine.

May 22. Michl. Croney, Dubney Bank, at Pomeroy.

May 22. John Christofery, Coalburg: explosion of fire-damp.

May 22. John G. Garabalda, Coalburg: explosion of fire-damp.

May 25. Thomas Lawson, Plummer Hill: fall of coal.

June 2. David Evans, Church Hill: fall of slate.

June 8. Crist. Colo, Burnet Bank: leg broken by fall of coal.

June 9. N. Gress, Minersville Bank, Pomeroy; collar-bone broken; died some weeks after.

August 7. Wm. Simm, caught between cars.

August 16. Jas. Davis, Coalburg: fall of roof.

August 16. Wm. James, Coalburg: fall of coal.

August 17. John Rames, Milton, Jackson county: leg broken.

August 22. Wm. Gross, Hamilton Mine: fall of roof.

August 23. Fred. James, Cramer Mine: struck with coal from a blast.

September 15. Thos. Kinney, Hubbard: fall of roof.

September 26. Samuel Jenkins, Pigeon Run Mine: fall of roof.

September 26. Edward Munday, Burnet Bank: very badly hurt by fall of coal.

September 30. John Carle, Empire Mine: very badly hurt by fall of coal,

October 1. David Jones, Stewart Bank, Coalburg: very badly hurt by fall of roof.

November 5. Wm. Rob, Town Bank, Zaleski: hurt in back by fall of roof.

November 5. Jos. Hamer, Zaleski: hurt in back and hips.

LIST OF FATAL ACCIDENTS DURING THE YEAR ENDING NOVEMBER 14, 1877.

November 24, 1876. John Drew, killed in mines of Nelsonville Mining Company, in Athens county: fall of roof.

December 16. Hubbard Smith, killed in Silver Creek Mines, Wayne county; fall of rock.

January 4, 1877. Nicholas Salvo, killed in Stewart Mine, Trumbull county: fall of roof.

February 8. Richard Bennet, killed at Curtis' Hill Mine, Trumbull county: fall of roof.

March 17. Aaron Craver, killed in Haroff Slope, Mahoning county: suffocated by gas.

June 21. Vengeance St. Augello and Dominic St. Angello, killed in Mine No. 3 of the Mahoning Coal Company, Trumbull county: fall of roof.

July 9. A boy (name not reported) killed in Warwick's Shaft, Stark county: explosion of powder.

July 10. William J. Thomas, killed in Aberdave Shaft, Stark county: fall of coal.

July 11. John Jones, Miles Davis, Richard Williams, David Jenkins, Richard Jones, John Barter, and John Young, killed in the Brookfield Slope tunnel, in Trumbull county: suffocated by the gases from the mine locomotive.

August 8. David Morgan, killed in Kyle Shaft, Mahoning county: crushed between cars.

August 10. William Hall, killed at Scott's Mines, Guernsey county; fall of coal.

August 12. August Henry, killed at Halliday Mine, Trumbull county: fell on his picks while going down the slope.

September 5. Salvo Matthio, killed in Hamilton Mine, Trumbull county; fall of roof.

September 6. Thomas Walton, killed in Stillwater Mine, Tuscarawas county: fall of roof.

October 2. James McLain, killed in air-shaft of Brookfield Mine, Trumbull county: fell down shaft.

October 6. Morgan Williams, killed in Shenango Mine, Trumbull county: fall of roof.

October 6. John Shousden, killed in Burnett Mine, Trumbull county: fall of coal.

October 11. William Clarke, killed in Pigeon Run Mine, Stark county: fall of roof.

October 19. William Cagg, killed in Tucker's Mine, near Straitsville, Perry county: fall of coal.

October 28. Thomas Plant, killed in Williamson Shaft, Stark county: fall of coal.

November 1. Thomas Simmons, killed in Ohio Coal Company's Mine, Cambridge, Guernsey county: fall of coal.

November 1. Luke Lemmon and William I. Williams, killed in Kyle Shaft, Mahoning county: fall of roof.

The list of fatal accidents number 30, the coal out-put (estimated) is equal to 5,125,000 tons, which is one fatal accident for every 170.666 tons of coal mined. The number of underground miners employed during the year is estimated at 13,000, making one death for every 433 men employed. The number of serious accidents were not furnished in full; few of them were furnished by the officers in charge of mines, and were, as were many of the accidents of a fatal character, collected by myself during official visits to the mines.

The deaths in connection with colliery operation in British mines were but 933, against 1,244 in the preceding year. If appears that 159,688 tons of coal were wrought for each life lost, whilst in the preceding year only 118,730 tons were wrought for each life lost, yet some districts show an unsatisfactory decrease in the quantity got for each life lost; in South Durham, for example, the figures are 255,408 tons, against 261,796 tons; and in East Scotland they are 168,029 tons, against 198,614 tons. During the year reported upon there were employed in and about the mines under the Coal Mines Regulation Act, 514,532 persons, who raised 134,125,166 tons of coal, 2,071,983 tons of fire-clay, 12,159,580 tons of ironstone, and 632,656 tons of shale, etc.,—together 148,989,385 tons. There was one life lost for each 551 persons employed. During the preceding year 133,306,485 tons of coal, 1,932,294 tons of fire-clay, 12,018,594 tons of ironstone, and 442,940 tons of shale, etc, were produced in the mines classed under the Coal Mines Regulation Act, including a quantity of iron pyrites, etc., found in working these mines. Comparing the above quantities it will be seen that the output of coal has increased less than 1 per cent. During 1875 there was one life lost for each 450 persons employed. The number of collieries at work in 1876 was 4,385, against 4,501 in the preceding year. We subjoin the usual tabulated summary, which will permit of the several classes of accidents being compared:

COAL MINES—1875.

NAMES OF DISTRICTS.	Separate Accidents.					Death Resulting.				
	Explosion of fire-damp.	Falls of coal, sides, and roof.	In shaft.	Miscel., in mine and at surface.	Total.	Explosions of fire-damp.	Falls of coals, sides, and roof.	In shaft.	Miscel., in mine and at surface.	Total.
Northumberland, Cumberland, North Durham	3	24	5	40	72	4	24	5	40	73
South Durham and Westmoreland	1	35	10	30	76	1	35	10	30	76
Cleveland ironstone	....	12	3	13	28	....	13	3	13	29
North and East Lancashire	1	33	10	19	63	2	38	11	24	75
Ireland	....	2	....	1	3	....	2	....	2	4
West Lancashire and North Wales	4	58	20	29	111	6	62	29	32	129
Yorkshire	6	61	9	28	104	162	62	11	28	263
Yorkshire coal-field ironstone	....	....	....	1	1	....	....	....	4	4
Yorkshire and Lincolnshire ironstone	....	....	....	....	....	....	....	....	....	....
Derby, Notts, Leicester, Warwick	1	26	16	21	64	1	26	17	21	65
Derby ironstone and fire-clay	....	1	1	....	2	....	1	1	....	2
North Staff., Cheshire, Salop	3	14	9	10	26	46	14	9	20	89
North Staff., ironstone	....	9	3	2	14	....	9	5	2	16
South Staff., and Worcestershire	6	35	11	17	69	6	36	12	21	75
South Staff., ironstone and fire-clay	1	3	2	3	9	1	3	2	3	9
Monmouth, Gloucester, Somerset, Devon	5	30	8	11	54	32	32	8	11	83
Monmouth ironstone	....	1	....	2	3	....	1	....	2	3
South Wales	4	41	21	37	103	20	45	22	39	126
South Wales ironstone	....	1	....	....	1	....	1	....	....	1
East Scotland	2	25	12	18	57	2	26	13	18	59
East Scotland ironstone and shales	....	2	2	1	5	....	2	2	1	5
West Scotland	4	20	7	9	40	5	20	7	13	45
West Scotland ironstone and shale	....	6	4	2	12	....	6	5	2	13
Total coal mines	40	404	138	270	852	287	422	154	299	1162
Total iron, fire-clay, and shale	1	35	15	24	75	1	36	18	27	82
Gross total	41	439	153	294	927	288	458	172	326	1244

COAL MINES—1876.

NAMES OF DISTRICTS.	Separate Accidents.					Deaths Resulting.				
	Explosions of fire-damp.	Falls of coal, sides, and roof.	In shaft.	Miscel., in mine and at surface.	Total.	Explosions of fire-damp.	Falls of coal, sides, and roof.	In shafts.	Miscel., in mine and at surface.	Total.
Northumberland, Cumberland, North Durham	2	34	5	26	67	3	35	5	27	70
South Durham and Westmoreland	2	42	5	26	75	5	42	5	26	78
Cleveland, ironstone	1	7	....	8	16	1	7	....	8	16
North and East Lancashire	3	22	5	14	44	5	24	7	15	51
Ireland	....	....	....	....	....	....	....	....	....	....
West Lancashire and North Wales	11	60	16	28	115	14	61	18	28	121
Yorkshire	3	35	9	22	60	3	35	9	22	69
Ditto, coal-field ironstone	....	1	....	....	1	....	1	....	....	1
Ditto, Lincolnshire ironstone	....	1	....	....	1	....	1	....	....	1
Derby, Notts, Leicester, Warwick	1	41	7	17	66	6	46	8	17	77
Ditto, ironstone	....	....	....	....	....	....	....	....	....	....
North Staff., Cheshire, Salop	3	17	8	14	42	11	17	8	16	52
Ditto, ironstone	....	2	....	2	4	....	2	....	2	4
South Staff. and Worcestershire	4	31	15	22	72	5	33	18	22	78
Ditto, ironstone	....	1	1	....	2	....	1	1	....	2
Monmouth, Gloucester, Somerset and Devon	4	28	6	9	47	29	29	6	9	73
Ditto, ironstone	....	1	....	....	1	....	1	....	....	1
South Wales	3	51	19	38	111	4	54	20	39	117
Ditto, ironstone	....	....	....	....	....	....	....	....	....	....
East Scotland	1	33	12	14	60	2	35	12	21	70
Ditto, ironstone and shale	....	3	4	1	8	....	3	4	1	8
West Scotland	4	18	5	4	31	7	20	5	4	36
Ditto, ironstone and shale	....	2	3	2	7	....	2	3	3	8
Total coal and fire-clay mines	41	413	112	134	800	94	432	121	246	893
Total ironstone and shale mines	1	17	8	13	39	1	17	8	14	40
Gross total	42	430	120	247	839	95	449	129	260	933

FINANCIAL STATEMENT.

STATEMENT OF TRAVELING AND CONTINGENT EXPENSES, FOR THE FISCAL YEAR ENDING NOVEMBER 14, 1877.

1876.			
November	14.	Postage	$2 00
"	14.	Wood-cuts, for Report	63 80
"	14 to 18.	To visiting Wadsworth and Doylestown mines	12 50
"	19 to 22.	To visiting mines in Hocking Valley	5 85
"	23.	Adams Express Company	25
"	23.	Letter-heads	50
"	25 to 29.	Visiting Coshocton and Steubenville mines	18 80
December	1.	Telegraph, and postage	1 00
"	2 to 5.	Visiting Mahoning Valley mines	11 50
"	7 to 10.	" Massillon mines	13 25
"	14.	Postage	2 75
"	14.	Gas fixtures for office	1 00
"	17 to 23.	Visiting Port Washington and Uhrichsville mines	9 40
"	28.	Postage	4 00
1877.			
January	1.	Care of office	10 00
"	4 to 7.	Visiting Wadsworth mines	8 55
"	12.	American Express	25
"	13.	Postage	5 00
"	17 to 24.	Visiting Mineral Ridge mines	18 50
"	26.	Postage	3 00
Jan. 30 to Feb.	3.	Visiting Millersburg and Massillon mines	14 50
February	9.	Postage	3 00
"	13 to 17.	Visiting Wellston and Jackson mines	19 75
"	19 to 21.	" Straitsville mines	2 75
"	22 to 26.	" Mahoning Valley mines	17 30
March	3.	Postage	4 30
"	9.	"	3 00
"	12.	Copying ink	50
"	14 to 18.	Visiting Steubenville mines	18 10
"	19.	Postage	4 00
"	20 to 28.	Visiting Nelsonville and Straitsville mines	10 50
"	28.	Expressage	30
April	1.	Care of office	10 00
"	2 to 7.	Visiting Hocking Valley mines	9 50
"	10 to 12.	" Coshocton mines	9 90
"	13.	Postage	1 00
"	14 to 21.	Visiting Mahoning Valley mines	24 50
"	23 to 28.	"	5 25
"	30.	Postage	3 00

Apr. 30 to May	5.	Visiting Mahoning Valley mines	$28 40
May	7.	Expressage	35
“	7.	Tableting paper	1 25
“	9.	Map cases	2 65
“	7.	Extending maps	25 00
“	12 to 19.	Visiting Steubenville and Bellaire mines	23 65
“	23 to 26.	“ Massillon mines	14 80
“	26.	Postage	3 00
“	28 to 30.	Visiting Hocking Valley mines	6 60
June	1 to 3.	“ Summit county mines	4 50
“	5.	Expressage	25
“	18 to 21.	Visiting Mahoning Valley mines	18 40
“	22 to 27.	“ Steubenville mines	21 65
“	28.	Postage	3 00
“	28.	Notary Public	25
July	2.	Care of office	15 00
“	2.	Extending maps	24 00
“	5 to 7.	Visiting Straitsville mines	3 00
“	8 to 17.	“ Brookfield slope	34 50
“	18.	Telegrams	1 06
“	18 to 21.	Visiting Nelsonville mines	2 40
“	26.	Expressage	50
“	28.	Postage	4 00
“	30.	Cleaning carpet	3 60
July 30 to Aug.	4.	Visiting Mahoning Valley mines	18 40
August	6 to 9.	“ Nelsonville mines	6 20
“	9 to 10.	“ Haydenville mines	2 20
“	13 to 22.	“ Mahoning Valley mines	28 25
“	22.	Postage	3 00
“	22 to 24.	Visiting Straitsville mines	2 60
“	27 to 30.	“ Clinton, Massillon, etc	16 50
Septem'r	1 to 9.	“ Mahoning Valley mines	28 50
“	9.	Postage	2 00
“	10 to 17.	Visiting Mahoning Valley	26 00
“	17.	Postage	5 00
“	18.	Telegram	40
“	24 to 28.	Visiting Salineville, etc	19 10
October	1.	Letter heads, etc	55
“	1.	Telegram	50
“	1 to 4.	Visiting Mahoning Valley	16 40
“	5.	Postage	3 00
“	11.	Care of office	15 00
“	20.	Postage	3 00
“	25.	Telegram	50
“	31.	Postage	3 00
Novem'r	5 to 7.	Visiting Straitsville mines	3 50
“	6 to 11.	“ Mahoning Valley	17 10
“	11 to 15.	“ “ “	16 73
			$832 29

During the four years I have held the office of Inspector of Mines, I have faithfully endeavored to discharge the duties required by law, and have been constantly employed in the work of mine inspection. I have made conscience of every dollar expended in traveling, or other expense connected with the office, doing for the State what I would have done for myself under similar circumstances.

Respectfully submitted.

ANDREW ROY,
State Mine Inspector.

LIST OF MINES, TOGETHER WITH NAMES OF OPERATORS, ETC.

ATHENS COUNTY.

Name of Mine.	Kind of Mine.	Name of Coal Company.	P. O. Address.
Lick Run	Drift	J. W. Scott	Nelsonville.
Laurel Hill	"	Laurel Hill Coal Co	Bretland.
Section 29	"	W. B. Brooks & Son	Nelsonville.
Harper's *	"	Harper Brothers	Nelsonville.
Coöperative	"	Nelsonville Mining Co	Nelsonville.
Poston's	"	Poston Brothers	Nelsonville.
Longstreth's	"	T. Longstreth	Nelsonville.
Star	"	Star Mining Co	Nelsonville.
Doanville*	"	N. Y. & O. Coal Co	Nelsonville.
Floodwood	"	B. B. Sheffield & Bro	Floodwood.
Hamley's Run	Shaft	G. F. Gould	Athens.
Salina	"	"	Athens.
Chauncey	"		
Big Run *	"	Federal Creek Coal Co	Big Run.
Carbondale	Drift	Carbondale Coal Co	Mineral City.
King's	"	King Brothers	King's Switch.

BELMONT COUNTY.

Barnesville	Shaft	Dawson & Roy	Barnesville.
Franklin	Drift	Stewart & Mehan	Stewardsville.
Kidd's	"	John Kidd	Shields.
Rainey's	"	W. J. Rainey & Co	Cleveland.
Etna	"	Etna Iron and Nail Co	Martin's Ferry.
Helling's	"	Henry Helling	Martin's Ferry.
Ohio City	"	Ohio City Iron and Nail Co	Martin's Ferry.
Belmont Works No. 1	"	Heatherington Brothers	Bellaire.
Belmont Works No. 2	"	" "	Bellaire.
Pittsburgh Works	Slope	Rocherhousen & Sterrett	Bellaire.
Empire	"	Thomas Corcoran	Shawnee.
Weegee	"	P. Shafar & Co	Weegee.
Union Works	"	Union Coal Co	Moundsv'e, W.Va.
Pipe Creek	"	Pipe Creek Coal and Iron Co	Dilley's Bottom.
Barnard's	Drift	W. G. Barnard	Bellaire.
Morgan's	"	E. G. Morgan	Bellaire.

CARROLL COUNTY.

Robertsville No. 1	Drift	Cleveland Iron Co	Salineville.
Robertsville No. 2	"	" "	Salineville.
Brown's Strip Vein *	"	Matthew Brown	Salineville.
Brown's Big Vein*	"	"	Salineville.
Dutchen & Davis	"	Dutchen & Davis	Salineville.
Tunnell Hill	Shaft	J. C. Card	Cleveland.
Welsh Mines	Slope	McDowell & Pratt	Mineral City.

COLUMBIANA COUNTY.

Washingtonville No. 1	Drift	Cherry Valley Iron Co	Leetonia.
Washingtonville No. 2	"	" "	Leetonia.
Leetonia Slope	Slope	" "	Leetonia.
Grafton	Shaft	Grafton Iron and Coal Co	Leetonia.
Empire	Drift	Ohio and Pennsylvania Coal Co.	Salineville.
Hayes	"	John Hayes	Salineville.
Farmer's	"	James Farmer	Salineville.

COLUMBIANA COUNTY—Continued.

Name of Mine.	Kind of mine.	Name of Coal Company.	P. O. Address.
Hartford	Drift.	O. & P. Coal Co	Salineville.
Rockville	“	“	Salineville.
O. and P	“	“	Salineville.
Granage & Anderson	“	Manufacturers' Coal Co	Salineville.
Foster	“	Harding & Sharp	Salineville.
Hussey Hollow	“	O. & P. Coal Co	Salineville.
Truesdale	“	Truesdale Coal Co	Salineville.
Robins'	“	New Lisbon Coal Co	New Lisbon.
Foster Mine	“	Shields Coal Co	Teegarden.
Rose Mine	“	Thomson & Coleman	Teegarden.
State Line	“	State Line Coal Co	East Palestine.
Prospect Mines	“	Prospect Coal Co	East Palestine.
O. and P	“	O. & P. Coal Co	Salineville.
Wolf Run	“	A. Armstrong	Teegarden.

COSHOCTON COUNTY.

Union	Drift.	Union Coal and Mining Co	Coshocton.
Blaen Nant	“	David Jones	Coshocton.
Rock Run	“	Rock Run Coal Co	Coshocton.
Summit	“	Franklin and Coalport Coal Co	Coshocton.
Coshocton	“	Coshocton Coal Co	Coshocton.
Diamond	“	Diamond Coal Co	Coshocton.
Cunesville	“	Ressler & Co	Newark.
Pen Twyn	“	Pen Twyn Coal Co	Coshocton.
Home	“	Home Coal Co	Coshocton.

GUERNSEY COUNTY.

Scott's	Drift.	Scott Coal and Salt Works Co	Cambridge.
Cambridge	“	Cambridge Coal and Mining Co	Cambridge.
Central	Shaft.	William Norris	Cambridge.
Nicholson	Drift.	Ohio Coal Co	Marietta.
Guernsey	“	Guernsey Mining Co	Cambridge.

GALLIA COUNTY.

Leadington	Drift	Leadington Coal Co	Cheshire.
Cheshire	“	Cheshire Coal Works Co	Cheshire.

HOCKING COUNTY.

Section 19	Drift.	W. B. Brooks & Son	Nelsonville.
Hayden's	“	Peter Hayden	Haydenville.
Gore	“	Thomas Iron Co	Gore.

HOLMES COUNTY.

Hardy *	Drift.	Hardy Coal Co	Millersburgh.
Myers	“	Bowen Bros	Millersburgh.

HARRISON COUNTY.

Philadelphia	Drift.	Philadelphia Coal Mining Co	Station 15.

JEFFERSON COUNTY.

Name of Mine.	Kind of mine.	Name of Coal Company.	P. O. Address.
Market Street	Shaft.	Steubenville Coal Mining Co	Steubenville.
Stoby Hollow	"	" "	Steubenville.
Gravel	"	Steubenville Furnace and Coal Co	Steubenville.
Everick's	"	Ohio and Pennsylvania Coal Co	Steubenville.
Boreland's	"	Swift's Iron and Steel Works	Steubenville.
Rolling Mill	"	Spaulding, Woodward & Co	Steubenville.
Mingo	"	Mingo Iron Works Co	Mingo.
La Grange	"	La Grange Coal Co	Phillipsburg.
Rush Run	"	Kamiusky & Rumsey	Rush Run
Bustard's	"	Steubenville Coal and Coke Co	Steubenville.
Alikana	"	Bell & Co	Steubenville.
Cable*	"		
Irondale No. 1*	Drift.	Morgan Iron Co	Irondale.
Irondale No. 2*	"	"	Irondale.
Irondale No. 3*	"	"	Irondale.
Hammondsville*	"	Hammondsville Coal and Coke Co	Hammondsville.
Strip Vein	Shaft.	Wallace & Sons	Hammondsville.
Diamond	Drift.	"	Hammondsville.
Strip Vein	"	Morgan Iron Co	Irondale.
Big Vein	"	"	Irondale.

JACKSON COUNTY,

Wellston	Shaft.	Wellston Coal and Iron Co	Wellston.
Milton	"	Milton Furnace and Coal Co	Wellston.
Star	"	Star Furnace Co	Jackson.
Tropic	"	Tropic Furnace Co	Jackson.
Orange	"	Orange Iron Co	Jackson.
Globe	Slope.	Globe Iron Co	Jackson.
Huron	Shaft.	Huron Iron Co	Jackson.
Erie	"	Erie Iron Co	Jackson.
Jackson Hill	Drift.	Price Brothers	Jackson.
Petrea	"	Petrea Coal Co	Jackson.
Jackson Hill	"	Thomas M. Kitrick	Jackson.

LAWRENCE COUNTY.

Sheridan	Drift.	Sheridan Coal and Iron Co	Sheridan.
Hanging Rock	"	Means, Kyle & Co	Ironton.
Bellford	"	Norton Bros. & Co	Ironton.
Old Mill	"	Iron and Steel Co	Ironton.
Lawrence	"	Lawrence Iron Works Co	Ironton.

MEDINA COUNTY.

Wadsworth	Slope.	Wadsworth Coal Co	Akron.
Diamond	"	Humphrey & Coleman	Akron.

MAHONING COUNTY.

Foster	Shaft.	Foster Coal Co	Youngstown.
Osburn	"	Andrews Brothers	Youngstown.
Kyle	"	Kyle Coal Co	Youngstown.
Wick and Wells†	"	Wick & Wells	Youngstown.
Austin	"	Tod, Wells & Co	Mineral Ridge.
Ohltown	"	Harris & Maurer	Mineral Ridge.
McKennie's shaft	"	J. B. Warner & Co	Mineral Ridge.
Tibbett's Shaft	"	Junction Coal Co	Mineral Ridge.
Fulk's	Slope.	Fulk Coal Co	Mineral Ridge.

MAHONING COUNTY—Continued.

Name of Mine.	Kind of mine.	Name of Coal Company.	P. O. Address.
Pennel	Slope	New Lisbon Coal Co	Youngstown.
Haroff	"	Haroff Coal Co	Youngstown.
Thorn Hill	"	Powers & Arms	Youngstown.
Packard's	"	Packard Coal Co	Youngstown.
Powers's	"	Powers Coal Co	Youngstown.
Holland	Drift	Charles Moore & Co	Youngstown.
Jackson	Slope	Jackson Coal Co	Youngstown.
Reno's	"	Powers Coal Co	Youngstown.
McKenny Slope	"	Mahoning Coal Co	Youngstown.
Walter's	Drift	Walters & Co	Washingtonville.

MUSKINGUM COUNTY.

Zanesville Mines	Drift	John Marpool	Zanesville.
Del Carbo	"	Consolidated Coal and Mining Co	Roseville.
Muskingum Valley	"	Muskingum Valley Coal Co	Roseville.
Matthews's	"	Lewis Matthews	Zanesville.
Monitor	Shaft	Cowell, Harris & Co	Zanesville.
Locust Grove	Drift	James Owens	Putnam.
Harper's Ferry	"	James Morrison	Putnam.
Coal Ridge	"	Orin Ballou	Zanesville.
Taylorsville	"	G. Scarval	Philo.
Crow Run	"	Stone & Deval	Cedar Run.
Blue Rock	"	James Patterson	Blue Rock.

NOTE.—There are from twenty-five to thirty other mines in this county, in the neighborhood of Zanesville, but they all work less than ten men at once.

MEIGS COUNTY.

Antiquity	Shaft	Ohio Coal Co	Racine.
Syracuse Shaft	"	Syracuse Coal and Salt Co	Syracuse.
Syracuse Slope	Slope	H. G. Daniels	Syracuse.
Pamunky	Drift	Pomeroy Coal Co	Pomeroy.
Williams's	"	Evan Williams	Minersville.
Minersville	"	Pomeroy Coal Co	Pomeroy.
Excelsior	"	" "	Pomeroy.
Pencreek	"	" "	Pomeroy.
Dabney	"	" "	Pomeroy.
Diamond*	"	" "	Pomeroy.
Coal Ridge	"	Coal Ridge Salt Co	Pomeroy.
Buckeye	"	Buckeye Salt Co	Pomeroy.
Middleport	"	Middleport Salt Co	Middleport.
Charter Oak	"	S. M. Pomeroy	Pomeroy.

NOBLE COUNTY.

Dexter*	Drift	Ohio Coal Co	Marcella.

PERRY COUNTY.

Central	Drift	Straitsville Central Mining Co	New Straitsville.
Old Straitsville	"	Straitsville Mining Co	New Straitsville.
Plummer Hill	"	Straitsville Coal Co	New Straitsville.
Troy	"	Union Coal Co	New Straitsville.
Tucker's	"	Lancaster and Straitsville Coal Co.	New Straitsville.
Mungen's	"	Consolidated Coal and Mining Co	New Straitsville.
Youart's	"	Patterson Coal Co	New Straitsville.
Upson's	"	Union Coal Co	Shawnee.
Shields's Mines, Nos. 1, 2, 3.	"	**Newark Coal and Iron Co**	**Shawnee.**

PERRY COUNTY—Continued.

Name of Mine.	Kind of mine.	Name of Coal Company.	P. O. Address.
New York	Drift	New York and Straitsville Coal Co.	Shawnee.
Lyonsdale	"	Straitsv. and Cannel C. Co. of N. Y.	Shawnee.
Furnace	"	Furnace Coal Co	Shawnee.
Shawnee Valley	"	Shawnee Valley Coal Co	Shawnee.
Taygue's	"	M. & P. Taygue	McLuny's.
McLuny	"	H. Jones & Co	McLuny's.
Tunnel Hill	"	Tunnel Hill Coal Co	New Lexington.
Selby	"	Selby Mining Co	New Lexington.
Wales's	"	Wales, Nugent & Co	New Lexington.
Crookville	"	Palmer & Haworth	Crooksville.
McCuneville	"	Crystal Salt and Coal Co	McCuneville.
Brilliant	"	J. E. Payne & Co	McCuneville.
Black Diamond	"	Black Diamond Coal Co	McCuneville.
O. K.	"	O. K. Coal Co	McCuneville.
Southern Ohio	"	Southern Ohio Coal Co	Maholm.
Anderson's	"	W. D. Anderson	Maholm.
Ferrara	"	Jas. Black	Moxahala.
Brindebal's	"	J. Brindebal	Moxahala.
Moxahala	"	Black & Son	Moxahala.

PORTAGE COUNTY.

Atwater Slope	Slope	Atwater Coal Co	Atwater.

STARK COUNTY.

Sippo Coal Co	.. ....	Russell, Davis & Co	
Fulton	Slope	Fulton Coal Co	Canal Fulton.
Buckeye	"	Buckeye Coal Co	Canal Fulton.
Crawford	Shaft	Crawford Coal Co	Massillon.
Crawford	Slope	" "	Massillon.
Willow No. 1	"	Rhodes & Co	Massillon.
Willow No. 2	Shaft	" "	Massillon.
Williamson	"	Howells, Lee & Co	Massillon.
Maple Grove	"	Massillon Coal and Mining Co	North Lawrence.
Aberdave	"	Youngstown Coal Co	Massillon.
Jacobs	"	Rhodes Coal Co	Massillon.
Grove	"	Grove Coal Co	Massillon.
Massillon Coal Co	"	Massillon Coal Co	Massillon.
Staeffer	Drift	J. P Burton	Massillon.
Warrington	Shaft	Warrington Coal Co	Massillon.
Brookfield	"	H. Foultz	Massillon.
Pigeon Run	"	Lee, Howells & Co	Massillon.
Lawrence	"	J. P. Burton	Massillon.
Foultz's	Slope	Massillon City Coal Co	Massillon.
Willow No. 3	"	Rhodes & Co	Massillon.

SUMMIT COUNTY.

Crawford's	Drift	Crawford & Co	Akron.
Franklin	Slope	Franklin Coal Co	Akron.
Summit	"	Summit Mine Coal Co	Akron.
Brewster Slope	"	Brewster Coal Co	Akron.
Brewster Drift	Drift	" "	Akron.
Brewster Bros	Slope	Brewster Bros	Middlebury.
Middlebury Shaft	Shaft	Middlebury Coal Co	Middlebury.
Johnson Shaft	"	Johnson Coal Co	Middlebury.
Dennison	Drift	Dennison Coal Co	Sherman.
Nemisilla	Slope	Nemisilla Coal Mining Co	Cleveland.
Norton's	"	Norton Coal Co	Sherman.

Name of Mine.	Kind of mine.	Name of Coal Company.	P. O. Address.
TUSCARAWAS COUNTY.			
Block Vein*	Drift	Block Vein Colliery Co	Dennison.
Dennison	“	Dennison Colliery Co	Dennison.
Andraes Mine	“	S. W. Andraes & Co	Urichsville.
Stillwater	“	Tuscarawas Valley Coal Co	New Philadelphia.
Syracuse	“	Syracuse Coal Co	Urichsville.
Pike Run, No. 1	“	Tuscarawas Valley Coal Co	New Philadelphia.
Pike Run, No. 2	“	“ “ “	New Philadelphia.
Rich Hill	Shaft	Rich Hill Coal Co	Waynesburgh.
Walton Ridge	Drift	Buckeye Coal and Coke Co	New Philadelphia.
Port Washington	“	Glasgow and Port Washington Iron Co	Port Washington.
Urichsville Shaft*	Shaft		
TRUMBULL COUNTY.			
Vienna†	Shaft	Vienna Coal and Iron Co	Youngstown.
Wheeler‡	Slope	“ “ “	Youngstown.
Tyler	“	C. H. Andrews & Bro	Youngstown.
Halliday	“	Halliday Coal Co	Youngstown.
Hood	“	Arms & Wick	Youngstown.
Sodom	“	McCurdy Coal Co	Youngstown.
Church Hill Slope	“	Church Hill Coal Co	Youngstown.
Church Hill Shaft	Shaft	Niles Coal Co	Youngstown.
Kline	Slope	Briar Hill Iron Co	Youngstown.
Moore*	“	Moore Coal Co	Youngstown.
Shenango	“	Shenango Coal Co	Wheatland, Pa.
Brookfield	“	Brookfield Coal Co	Sharon, Pa.
Burnett	“	Burnett Coal Co	Youngstown.
Stewart	“	Mahoning Coal Co	Youngstown.
Long Bank	“	“ “	Youngstown.
Mahoning, No. 3	“	“ “	Youngstown.
New Bank	“	“ “	Youngstown.
Cleveland	Shaft	Payne, Newton & Co	Cleveland.
Ashland	Slope	Ward, Warner & Co	Mineral Ridge.
Weathersfield	Shaft	H. A. Wick & Co	Mineral Ridge.
Cambria	Slope	W. Williams & Co	Mineral Ridge.
Love	“	Andrews & Hitchcock	Youngstown.
Williams	Shaft	D. Williams & Co	Hubbard.
Winfield	Slope	Winfield Coal Co	Mineral Ridge.
Curtis Hill	Drift	Curtis & Boyce	Sharon, Pa.
VINTON COUNTY.			
Vinton Shaft	Shaft	Bancroft & Rader	Vinton Station.
Coalmont	Drift	Zaleski Coal Co	Zaleski.
Zaleski	“	“ “	Zaleski.
Moonville Mine	“	Richard Coe	Moonville.
Buckeye	“	King Bros	King's Switch.
WAYNE COUNTY.			
Fairview	Shaft	J. P. Burton	Massillon.
Crawford‡	Drift	Crawford, Scott & Co	Massillon.
Silver Creek, No. 1	“	Silver Creek Mining Co	Doylestown.
Silver Creek, No. 2	Shaft	“ “ “	Doylestown.
Silver Creek, No. 3	“	“ “ “	Doylestown.
WASHINGTON COUNTY.			
Washington*	Drift	Washington	Youngstown.
Cliff Mines	“	G. W. Lyne	Coal Run.
Macksburg	“	Ohio Coal Co	Marietta.

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* Idle. † Drowned. ‡ Worked out.

APPENDIX.

The following was received too late to be inserted in its proper place in the report, but is of so much importance, to both mine owners and miners, that its insertion here is deemed advisable and necessary:

INJUNCTION AGAINST THE KYLE SHAFT, IN MAHONING COUNTY.

BEFORE JUDGE E. B. TAYLOR.

In the Court of Common Pleas of Mahoning County, State of Ohio. The State of Ohio, on relation of Andrew Roy, State Mine Inspector, Plaintiff, against Daniel B. Stambaugh and others, Defendants.

This action is brought under the act of March 21, 1874, and the petition alleges that the defendants are the owners of, and are now working a certain coal mine, situated in the county of Mahoning, known as the Kyle bank, and that it is a mine worked by a shaft, where more than ten men are employed at the same time, and in which more than fifteen thousand square yards have been excavated.

The petition further alleges that there are not two separate outlets separated by natural strata, of not less than one hundred feet in breadth, by which outlets distinct means of ingress and egress are always available to the persons employed in said coal mine, and prays for an injunction as provided in section fourteen of said act.

The evidence sustains fully all the allegations of the petition. In fact, all the conflict of testimony is upon the point as to whether there is two ways of ingress and egress, the defendants claiming that in addition to the main shaft, the air shaft furnishes the means of ingress and egress, being provided with ladders for that purpose. This air shaft is in size about five by seven feet, one hundred and forty feet in depth, and situate from the down shaft about two hundred and fifty yards. Near its foot is kept the fire by which the mine is ventilated, the smoke and gases of which escape through the shaft.

While there is some conflict in the evidence as to whether the air shaft can be made always available for the purpose of entering into or escaping from the mine, the witnesses substantially agree that when a fire is burning at its foot, and it must always burn while men are working, that a delay must occur before one can pass up the shaft, a delay sufficiently extended to allow the fire to be drawn, occupying a period of from ten minutes to two hours and a half, as fixed by different witnesses.

It is true that much danger is necessarily incurred in coal mining under even the most favorable circumstances, but when we consider the effect of an accident occuring in a mine among a large number of workmen, which would render them anxious to immediately escape, and the possibility of a panic occurring if delayed in their attempt, I can not avoid the conclusion that the way of escape through the air shaft by means of ladders, though much better than none, is not the "means of ingress and egress always available to the persons employed in the mine," provided for in section eight of the act referred to. The language of the statute is too plain to admit of such construction.

It requires the defendants to provide at least two distinct ways of escape from their mine, both of which must be always open and ready for use, for their employés working in the mine. Nothing less than this can meet the requirements of the statute, and as the defendants have failed thus to provide, the injunction prayed for must be allowed.

FIFTH ANNUAL REPORT

OF THE

STATE MINE INSPECTOR,

TO THE

GOVERNOR OF THE STATE OF OHIO,

FOR THE YEAR 1878.

COLUMBUS:
NEVINS & MYERS, STATE PRINTERS,
1879.

FIFTH ANNUAL REPORT

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NEVINS & MYERS, STATE PRINTERS.
1879.

ANNUAL REPORT.

COLUMBUS, OHIO, *December* 31, 1878.

To His Excellency R. M. BISHOP, *Governor of Ohio:*

SIR: In compliance with the requirements of the law under which this office was created, I have the honor to submit the following report:

I entered upon the discharge of the duties of this office May 1, 1878, consequently this report comprises only the last eight months of the past year.

The coal industries of Ohio increased with wonderful rapidity, and to such an extent that, in 1872, over twelve thousand miners were employed in this State.

Unlike most trades or avocations, that of mining coal is fraught with great peril to the lives of persons engaged in its subteraneous working. The miner alone in his room, shut off from all light except the dim flickering of his lamp, frequently breathing impure air, and, at times, when apparently safe, slowly inhaling deadly gases, until he falls into a stupor, from which he never recovers; or, when at work, little dreaming of impending danger, the sudden explosion of dangerous gases either instantly kills him, or he is borne to the surface burned almost beyond resemblance, and in a dying condition; or he is liable to be crushed by great masses of slate or rock suddenly falling from above. Escaping all these, he is liable to fall a victim to some disease of the lungs caused by his breathing foul air and coal dust; and, in short, he is constantly surrounded by great dangers, and his life depends almost entirely upon those in charge of the mine in which he works.

The alarming fatality among this class of workingmen caused the passage by the Legislature of this State of the act known as the

MINING LAW,

Which was chiefly intended to so regulate the working of coal mines and the duties of persons having charge of mines, that the dangers of mining would be greatly diminished, and the lives of the miners protected.

In section two of the act referred to is the following: "And it shall be the duty of the person having charge of any mine, whenever loss of life shall occur by accident connected with the working of such mine, or by explosion, to give notice forthwith by mail, or otherwise, to the

Inspector of Mines and to the coroner of the county in which such mine is situated, and the coroner shall hold an inquest upon the body of the person or persons whose death has been caused, and inquire carefully into the cause thereof, and shall return a copy of the verdict and all the testimony to such inspector."

Unfortunately, no penalty is attached for a non-compliance with the law, and, I regret to say, that but little attention is paid to it by persons in charge of mines, or by coroners holding inquests under its provisions. This was also the case in the State of Pennsylvania until the Legislature of that State passed an act making a failure to comply a penal offense, and providing a heavy penalty in case of such non-compliance.

In examining the reports of my predecessor, I find he has several times called attention to this fact, and I most earnestly recommend that legislation may be had on this subject, as the law is practically a dead letter as it stands at present.

In the State of Pennsylvania, when an accident occurs in a mine, the operators are not allowed to do any work in that portion of the mine affected by such accident (except such as is immediately necessary to prevent additional loss of life or property), until after it has been inspected by the inspector of the district in whose division the mine is situated. This enables the inspector to make a thorough examination into the causes which led to the accident, and to place the responsibility where it properly belongs.

In this State, however, when an accident occurs, almost the first thing done is to repair that part of the mine and continue operations, and in a few days all traces which pertained to the cause of the accident have been either removed or so obliterated as to prevent a comprehensive examination in regard to the cause of the accident.

Very few accidents occur in coal mines which are not directly due to want of caution on the part of the miners, or to culpable negligence or want of proper knowledge of the science of mining on the part of the person having charge of the mine.

In countries where mining has been carried on for a long time, the necessity for having the mines in charge of skillful and competent men is fully appreciated. Many countries have established mining schools for the education of persons intending to follow that particular branch of business. The result has been a very desirable one; as competent management not only protects the lives and health of the miners, but also the property of the operators, and facilitates the working of the mines to the best possible advantage.

It is not generally understood to what a great extent the lives and health of miners depend on the knowledge and action of the bank boss, superintendent, or the person having immediate supervision of the mine. Upon the latter falls the responsibility of supplying pure air, preventing an accumulation of poisonous gases, keeping the mine free from water, and, in fact, the general sanitary condition of the mine. He should be competent to survey the mine, or, if he is not, should have the mine surveyed at proper intervals by a competent party.

THE COAL FIELDS OF OHIO.

The coal district of Ohio comprises a space of about 180 miles in length by 80 miles in width at its widest part, having an area of about ten thousand square miles. The counties principally underlaid with coal are Athens, Belmont, Carroll, Columbiana, Coshocton, Gallia, Guernsey, Harrison, Holmes, Jefferson, Lawrence, Mahoning, Meigs, Morgan, Monroe, Muskingum, Noble, Perry, Stark, Tuscarawas, and Washington. The counties only partially in the coal measure are Fairfield, Hocking, Jackson, Licking, Medina, Scioto, Summit, Trumbull, Vinton, and Wayne. There are also found small detached basins in Ashland, Knox, Richland, and Wayne. The coal district proper extends from Trumbull county, on the north, to the Ohio River, at Scioto county, on the south, and from thence eastward, over western Pennsylvania.

There are nine coal seams in Ohio from which coal is mined to a greater or less extent. Most of these seams are of local importance only, but several of them are directly traceable throughout the entire Alleghany coal field, and many eminent geologists consider them identical with the coal found in Indiana and Illinois.

COAL NO. I

Is known by a variety of local names, taken from the various localities where it is mined; as, in Jackson county, it is called the "Jackson coal;" while, going north, we find it called "Lower Muskingum," "Massillon," "Mahoning," "Briar Hill," etc. In Pennsylvania it is called the "Sharon."

This coal has been much more sought after than any other seam. For many years it was considered the only coal entirely suitable for blast furnaces, and at present it is used for smelting iron to a greater extent than any of the other seams, although it has found a formidable rival in the "Great Vein," or No. 6. Although continuous, it is very irregular, and I can safely say that more money has been expended in prospecting for this coal than has been for all the other seams together.

It is chiefly mined through shafts, and lies in spots; it frequ happens that by drilling one hole it is found well developed, while a hole may be put down within a hundred yards of the first and no coal of value found, a worthless shale appearing in its stead.

COAL NO. II

Is usually found about sixty feet above No. 1, and is of little importance except with some few local exceptions. It has been found five feet thick in Holmes county, but is neither regular or continuous.

COAL NO. III

Lies about eighty to one hundred feet above No. 2, and is worked, to a limited extent, at various points for local use; in a few localities, however, it assumes considerable importance, and is extensively mined in the counties of Columbiana, Stark, and Tuscarawas, and ranges from three and one-half to seven feet in thickness. It is commonly called the "New Lisbon coal."

COAL NO. IV

Lies from forty to sixty feet above No. 3. It is very irregular, but, like No 3, is frequently found as *cannel coal.*

COAL NO. V

Lies about sixty feet above No. 4, and is quite persistent, but varies greatly in quality. It is extensively mined in different localities, and varies, where mined, from three and one-half to five feet in thickness.

COAL NO. VI.

From thirty to sixty-five feet above No. 5, is found Coal No 6, known as the "Great Vein," which comprises in amount over one-third of all the coal in the State. It is continuous, and the most regular of any of the seams found in the State. Its thickness varies from four feet in Holmes county, to fifteen feet four inches on Sunday Creek, in Perry county, where it attains its greatest thickness.

The following article, written by Prof. Newberry, is taken from the Geological Survey of Ohio, Vol. 2, compiled in 1873:

"This coal (No. 6) is probably the most interesting and important of all our coal seams. It attains greater thickness, occupies a wider area, and in its different outcrops and phases supplies a larger amount of good fuel than any other. It also seems destined to make, in the future, still more important contributions to the wealth of the State. In the remarkable section which terminates the coal-field at its northwestern corner, in Holmes county, Coal No. 6 is only two feet in thickness, but it is here partially cut away by the heavy sand-rock (Mahoning sandstone) which overlies it in so many localities. A few miles further east, near Millersburg, at the mine of Judge Armor, it is six feet thick, in two benches, the parting being near the middle.

"Here it exhibits a character which it generally holds throughout northern Ohio, viz.:

it is rather soft, but very bright and black coking coal, containing a moderate amount of sulphur, but too much to permit its employment for the manufacture of gas.

"Throughout Holmes county Coal No. 6 is almost constantly present, running from three to six feet in thickness, and is the source from which most of the fuel used by the inhabitants is supplied.

"In Tuscarawas county it is likewise the most important seam. On Stone Creek it is thin, but in adjoining localities it ranges from four to five feet thick. At Port Washington it is seven feet thick. Elsewhere, as at Trenton, Uhrichsville, Dennison, Pike Run, New Philadelphia, the Goshen Salt Well, and in the valley of the Connotton, it is nearly of the same thickness, from four to five feet.

"At Uhrichsville it is quite largely mined and coked by Mr. Andreas. The Trenton mines have supplied a large amount of this fuel to the Cleveland market for the last five and twenty years. Throughout all this region it is a typical coking coal, which will make an excellent coke if properly washed.

"In Stark county, Coal No. 6 runs through all the southern and eastern townships. It is the coal mined at Osnaburgh, and highly esteemed in all parts of the county for blacksmiths' use. Throughout Mapleton, Robertsville, and Paris, this coal is from four to six feet in thickness, and fully up to its average of excellence.

"Near New Chambersburg, it crosses the line of the Cleveland and Pittsburgh Railroad, and stretches thence continuously through the highlands of the water-shed far into Pennsylvania. At Salineville, Hammondsville, and Linton, it is called the "Big Vein," and ranges from five to seven feet in thickness—a coking coal not quite as pure as further west.

"At Linton it is underlaid by four or five inches of cannel, which is full of the remains of aquatic animals, and is plainly the carbonaceous sediments of an open lagoon in the coal marsh. About fifty species of fossil fishes and salamanders have been taken from one mine at this locality.

"Just above Steubenville, Coal No. 6 dips below the river, and this is the seam mined in the shafts at this point, Mingo, Lagrange, Rush Run, etc. At Steubenville it is about four feet in thickness—a partially open-burning coal of great excellence. It has been considerably used in the raw state for the manufacture of iron, but is now more generally coked. At Rush Run it is from seven to eight feet in thickness, but is not quite so pure as at Steubenville, and is more broken by partings.

"In all the northern part of Columbiana county this coal is found in an almost unbroken sheet. Near New Lisbon it is the coal mined on the Shelton, Arter, Teagarden, and Martin farms, ranging from four to seven feet thick.

"About Achor and Palestine, on the eastern line of the county, the Coal No. 6 becomes purer, but somewhat thinner than further west.

"This is the seam mined at Carbon Hill, and in this region is generally known as the 'four foot' or 'Carbon Hill' seam.

"At Achor it is mined by several parties; the coal is from three and a half to four and a half feet thick, and very clean, bright, and pure.

"At the Sterling mines Coal No. 6 is worked by Freeman Butts, Esq, and is largely sold as a gas coal. Throughout eastern Columbiana county, and over a large area in western Pennsylvania, Coal No. 6 is underlaid by a bed of limestone of from two to eight feet in thickness; but this disappears, or is only occasionally seen toward the west. By the Pennsylvania geologists our Coal No. 6 is called the *Upper Freeport* seam, and the limestone under it is called the *Freeport limestone*.

"Going south from our starting-point in Holmes county, we find that Coal No. 6, in

Coshocton, exhibits an excellent development. It is mined in a great number of places—for the most part retaining the characters that have been already attributed to it.

"Here, as elsewhere, it usually lies in two benches, with a parting usually below the middle. At Coshocton, and in that vicinity, it is harder and purer than further north; it is largely mined and shipped on the Pittsburgh, Cincinnati and St. Louis Railroad.

"Though not yet used for iron-making, if properly coked, the coal of this seam in Coshocton county would supply a very large amount of good furnace fuel.

"South of the National Road Coal No. 6 acquires such magnitude and excellence that it quite over-shadows all the other coal-seams of the State. In Muskingum county it has much the appearance it has further north, but is not so thick and pure as in Coshocton. In the adjoining county of Perry it expands to a maximum thickness of nearly thirteen feet, and is the 'Great Vein' of the Straitsville region. It is also of excellent quality, is open-burning furnace coal, containing a small amount of sulphur, and is successfully used for the manufacture of gas.

"The identity of the Straitsville coal with No. 6 will hardly be questioned by any one who follows the seam down through its line of outcrops and mines by which it is connected with the No. 6 of Coshocton, Holmes, and Tuscarawas. It is always recognizable by its dimensions, its partings, and by its relation to the Putnam Hill limestone and Coal No. 5 below, and to the Cambridge coal and to the Crinoidal limestone (Ames limestone) of the Barren Measures above. What the reach of Coal No. 6 toward the east and back from its line of outcrop in Perry and Athens may be, we do not know, but it has been struck in borings in numerous localities where it had passed one hundred feet below the surface, here maintaining a thickness of from eight to twelve feet. It is highly probable that it extends beneath a large tract of country east of where it is now mined, where it is, far below the surface, readily accessible by shafts.

"It will be remembered that in passing southward on the Ohio, Coal No. 6 becomes thicker than further north, and we are thus encouraged to hope that its greatest development is in this direction.

"The Straitsville coal has not been certainly recognized south of Athens county. If extending further in this direction, it is, on its western outcrop, much diminished in thickness and value."

Since the above was written, the superiority of the smelting qualities of this coal in the Hocking Valley, Straitsville, and Shawnee regions, has been fully demonstrated, and thirteen stone coal blast furnaces have been erected in these localities, which depend entirely on No. 6 coal for their fuel.

This, with the ore and limestone found in that section, produces pig iron at a very low figure, and of a very desirable quality. The coal in this section was first developed for shipping purposes in 1870, and already furnishes employment to over four thousand miners (including ore miners). The rapid increase of the output was such, that, in 1878, over one million two hundred and eighty five thousand tons were shipped to market, besides nearly three hundred thousand tons which were used by the furnaces.

COAL NO. VI *a*

Is usually found about forty feet above No. 6; it is commonly called the

"Norris coal," and until quite recently has not been considered of much value.

During the last six months, however, it has been found in large deposits, in Perry and Athens counties, of an excellent quality.

It reaches its maximum thickness on Sunday Creek, in Perry county. On the lands of the Ohio Iron Company, near Ferarra, it has been recently developed, and found to be of an excellent quality, comparatively free from sulphur, and particularly adapted to making a coke for furnace use.

This company propose to give it a trial in their iron works at Zanesville, as soon as the Sunday Creek Railroad (now building) is completed to their mine.

Should this coal coke as well as expected, it will be a great benefit to this already well favored district.

COAL NO. VII

Should lie about fifty to sixty feet above No. 6 A.; it is known by a variety of local names, "Bayley's Run," "Leèsburgh," "Salineville top vein," "Cambridge," etc. At some points its quality is very good, although it usually contains a large percentage of sulphur. *

COAL NO. VIII

Is about four hundred feet above No. 7, and is extensively mined in different localities, principally along the Ohio River, where it is usually designated "Pomeroy coal."

This coal is the lowest one of what is geologically designated as the "Upper Coal Measure." Between No. 7 and No. 8 is about four hundred feet of sandstone and shale. This section is called the "Barren Measure;" although traces of coal have been discovered in it, there have been no good developments found. There are several thin veins found above No. 8, but with some local exceptions, have but little importance.

MINING.

Diodorus Siculus gives a more minute account of the mining processes of the Egyptians under the Ptolemies, than we possess of any other ancient people. To the working of the gold mines upon the confines of Egypt, criminals and prisoners of war were condemned. Recent discoveries have also conclusively shown that mining was carried on long ago, in the copper regions of Lake Superior and the silver districts of New Mexico.

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* Since the above was written I have learned of some recent and valuable discoveries of this coal found in Athens and Perry counties. Near Nelsonville it has been found, very free from sulphur, and in large deposits. Extensive preparations are in progress for coking this coal, and the fact of its being so near the iron furnaces, renders it very valuable.

While the implements employed by the workmen of these ancient mines were only rude hammers of stone, indicating but little progress in the mechanical arts, the immense amount of labor bestowed upon the work of extracting the metallic products, showed the high value which an ignorant race set upon the metals.

As mankind advanced in the arts and civilization, new properties and uses of minerals were frequently discovered, till mining has grown to be one of the chief industrial pursuits of man.

As mines were worked in ancient times, and are yet among barbarous nations, the applications of labor-saving machinery are few and exceedingly rude. The rock through which the shafts are sunk and the horizontal galleries are driven, is slowly broken off, sometimes by the aid of fires kept burning against it, and the fragments are laboriously brought to the surface upon the heads or shoulders of the workmen, who climb by insecure steps cut in the slopes, or by ladders formed of single logs with sticks for rounds inserted in their sides. Even the water which flows in is sometimes removed in the same way, or drawn out by hand.

The simple windlass was a great invention for the miner, and is now universally in use for the sinking of shafts to moderate depths, and even for prosecuting mining operations to some extent. For heavier work the horse whim has been introduced in modern times. This is a drum attached to a vertical axle and carried around by one or several horses secured to its horizontal arms.

Around the drum, which corresponds to the barrel of the windlass, the rope is wound, the ends of which pass over pulleys and down the shaft, supporting the buckets in which the material to be raised is drawn up. Where water power was conveniently at hand, this has been used for the same purposes. With the invention of the steam engine, more efficient machines of various kinds were brought into use; and when this was applied to mining purposes in 1765, by Watt, in Cornwall, it was soon found that much more powerful hydraulic apparatus could be used than was ever before applied to mining, and large pumps with heavy cast iron pipes, capable of supporting a pressure of a column of water several hundred feet high, were substituted for the clumsy wooden pumps that had been previously in use. Thus the means were afforded of carrying the workings to greater depths than were ever before reached, and of raising to the surface the immense bodies of water that continually collect in deep excavations, as also of vastly larger quantities of material.

The large transportation of the products of coal mines led to the invention of railways, which, constructed of wood, were laid from the mouths of the shafts at the collieries in the north of England down to the places of shipment, and were in use for about two hundred years before they were applied to other purposes. More recently introduced in the long levels of the mines, the tracks of wooden or iron rails have greatly added to the facilities of removing the excavated materials. In this direction the mining art has been greatly advanced by modern improvements.

In the long, narrow, often poorly ventilated passages, the smoke of the powder, after blasting, long keeps the men from their work, and envelopes them a great part of the time in an unhealthy atmosphere. The air is further vitiated by the numerous lamps and candles required for light, and also by the breathing of the men and horses, or mules, which are employed in large mines. Its temperature also is raised by the same causes, as well as by the general increase of heat with increasing depth. Ventilation is, therefore, a matter of the first necessity, and should be provided for in all mines by the arrangement of the shafts and levels, so as to secure a downward current of air through the lower openings, and an ascending current through the shafts, at the mouth of which chimneys are sometimes raised to increase the draft. In collieries, where noxious or explosive gases are generated, and thorough and rapid ventilation is all important for the safety of the workmen, furnaces or fans should be located at or near the "upcast" shafts, by which a powerful draft is created, and currents of air are drawn along through distant parts of the mine. Revolving fans and other machines are also employed to drive the air through the passages, which will be referred to under the head of ventilation.

The mineral treasures of the earth are found not scattered indiscriminately in any country, or in any rock formation, but mostly limited to certain groups of rocks, and usually to certain districts. The discovery of a valuable mine in any long settled country, out of one of these districts, may always be regarded as extremely improbable.

COALS AND COLLIERIES.

The use of coal by the English is traced back many centuries. Historical mention is made of the trade of Newcastle in this material, in the year 1281. Its use in London was prohibited in the reign of Edward I, the smoke being then regarded as injurious to health.

But, though by several acts of Parliament, its employment continued to be prohibited; the mineral fuel, as wood became scarce, found its way as a substitute; and from the time of Charles I it has been the common fuel, not only of London, but of the greater portion of the island.

The steam engine immensely multiplied the demand for it; it was found useful in various mechanical and metallurgical arts, some of w owe their importance wholly to this new source of power, as it n be called. Its application to the production of gas for illumination, further increased the demand; as at a later period has also its newly discovered capacity for producing valuable oils and other highly combustible compounds.

The consumption in Great Britain increased to such an extent that the coal mines became an essential element in the prosperity of the kingdom. In no other country was the production to be compared with that of its mines, and no where did manufacturers and commercial prosperity, dependent on the use of steam on land and sea, so rapidly increase.

Undoubtedly England's wealth as a nation is directly attributable to her immense deposits of coal.

OHIO COAL.

In 1755 coal was discovered near Bolivar, in Tuscarawas county, by its being seen on fire. It was first practically developed in Tallmadge, in 1820, for blacksmithing purposes. At present nearly twenty thousand persons are actively engaged in coal mining, and in connection with the iron industry, which is dependent on it, it is by far the leading industry of this State.

Ohio ranks second in the Union as a coal producing State, last year nearly six million tons being mined in the State.

It is very generally understood that coal lies in seams, these following in different localities different directions, as in Pennsylvania these seams frequently run in a vertical direction, and occasionally may run vertically for a distance and suddenly change and follow a rolling course, sometimes vertical and sometimes horizontal.

In this State, however, the coal seams invariably lie in a horizontal position, except usually a dip of from twenty to thirty feet to the mile, toward the Ohio River. As these seams are sometimes found high up on the hillsides, and in other cases hundreds of feet below the bottom of the valleys, it is readily seen that different methods have to be used to meet the varied requirements. The principal methods made use of are known as the "drifts" and "shafts," which latter includes what are sometimes called "slopes."

DRIFT SYSTEM.

In their simplest form, as seen in the bituminous coal-fields west of the Alleghany Mountains, where the strata lie nearly horizontally, and the coal beds included among them, pass upon a level through each hill, the collieries employ little or no machinery. Narrow passages are excavated in the coal. A track is laid upon the floor or bottom underlying the coal, for the bank cars or wagons to run on, and the entry and track are extended as the excavation proceeds. In the smaller banks men or boys push the coal wagons out by hand; but in the larger drifts, mules are required. The cars are made to discharge themselves on the outside. The mules are very easily taught this kind of work, and will come out with loaded cars and return alone into the dark passages of the mine with the empty cars.

Within the hill the passages branch out in various directions, generally after a regular plan of gang-ways and chambers, so laid out that the greatest amount of coal can be safely removed with the least amount left as pillars to support the superincumbent strata. Logs of wood, set on end, and called props, aid to support this weight, but when the locality is nearly exhausted, the pillars of coal may at last be removed, commencing at the extreme portions, and letting the whole mass above gradually settle down.

In these works, simple as they are, two sources of trouble must be provided against, as in the collieries of greatest pretensions. Air circulates slowly through long under-ground passages, in the warm, sultry weather especially, not entering more than one hundred yards in a state sufficiently pure for men to continue at work and for candles to burn. Shafts sunk from higher ground down to the workings act as chimneys, and cause a free circulation of air; but it is not always convenient or practicable to sink these shafts. Gang-ways, coming out to the surface at two or more points, and connected together within, tend to cause a circulation of air through all their extent. Artificial means, however, should be generally employed, as exhausting air by a fan or furnace from the extreme workings.

The other cause of trouble is the collecting of water in the mine by the bed sloping away from the entrance. This involves cutting a drain to the level of the lowest working, or opening the mine at a lower point on the dip of the bed, removing the water by pumping, or, as is frequently done, hauling out the water in water-tight cars.

As the expense of ventilation and drainage in a poorly adapted mine sometimes exceeds the actual cost of extracting the coal, it is apparent that the position of a bed with relation to the facilities of effecting these requisites is a subject of the first importance.

Many properties containing a coal bed of excellent quality are rendered of little value by the strata sloping in, while others adjoining, having the same bed, are worked to profit by reason of being situated upon a lower line of the outcrop.

Difficulties are often encountered from the unsou
which is commonly of black slate, and, unless in h

not easily sustained except with numerous props. Sometimes even the upper layers of the coal bed must be left for the roof.

THE SHAFT SYSTEM.

The shaft is usually sunk with particular reference to the permanent drainage of the mine, and for this reason is located in a position to reach the coal bed at a lower level than that of the great body of the coal to be excavated. It may pass through several different coal beds, all of which may be worked by means of it. The water circulating among the strata above, finds its way into the sump or pit sunk at the bottom of the shaft, and is pumped from this to the surface. The same shaft may be used for hoisting to the surface the coal and slate removed in the excavation, and may also serve to aid in the ventilation of the mine, and, again, as a way of ingress and egress to and from the mine for the miners and other under-ground employés.

When intended for all these purposes, it is made of large size—fifteen feet or more in length by seven or eight feet in width—and divided by board partitions into several shafts extending to the bottom. Shafts, however, are often made of circular or elliptical area, and from ten to fifteen feet in diameter. These, too, are divided into three parts.

The sinking of a main shaft in the deep basins of the English coal fields, is often an undertaking of great importance, involving heavy outlays, sometimes extending through several years, before the coal bed is reached. "The depth and nature of the alluvial cover to the rock strata," says a recent writer, "the weight of water to contend with, engine power, arrangements for future ventilation, beside many local difficulties for which no rule can be applied, are all points requiring the greatest deliberation and forethought. And when we consider that the deepest shaft in Great Britain was sunk and fitted up with engine power, etc., at an outlay of £100,000 ($500,000), extending over a period of ten years, we will then be able to form an idea of the cost and time generally required for such operations, however simple."

Tomlinson mentions that £50,000 has often been expended before the coal seam intended to be worked was reached.

A considerable portion of the expense incurred in these works is in arresting the flow of quicksands, which are often encountered near the surface, and also the influx of water, streams of which are met with at all depths.

This is accomplished by a system of "tubing;" which is encasing the shaft in a lining of thick plank, braced within by sets of timber arranged at intervals around the sides.

For round shafts, cylinders of cast iron have for some time been successfully used in England, made in sections, which are lowered into the shaft and fitted, water-tight, into places prepared for them.

Quicksands, and treacherous ground of this nature, must first be kept back and temporarily secured by a tight wooden casing, within which the permanent one is placed.

The tubing of the upper part of the shaft, above the solid rock and resting upon it, is sometimes constructed of brick or stone work, laid in hydraulic cement.

From the bottom of the shaft, entries are driven in different directions in the coal, following its course for an indefinite distance, and gradually carried on, as the mine continues to be worked, till, in some mines, they may be traversed for miles.

The mine is so divided that solid blocks of coal form pillars which support the roof. These are finally removed and the roof allowed to settle down, and the old abandoned workings frequently fill with choke-damp, making it dangerous to enter them.

Very curious effects are seen in some of the mines, resulting from the immense pressure upon the pillars of coal. The strata forming the floor, when of a soft nature, curve upward more and more, until at last they fill the vacant space. The roof, when soft, is sometimes forced down, producing the same effect. The former movement is called a creep, the latter a sit.

The coal, when mined, is loaded into cars, which are hauled to the bottom of the shaft and run upon cages or platforms of the elevator; a signal is given to the engineer above by means of a wire extending from the bottom to the top and there attached to a bell. The coal is finally screened, when it is ready for market.

DANGEROUS GASES COMMON TO COAL MINES.

A scientific writer gives the following graphical description: "In the deep bituminous coal mines, a complete system of ventilation is of the utmost consequence; for, beside the foul air generated by the breath of men and horses, by the burning of candles and lamps, the inflammable gases issue in jets, called blowers, from the crevices in the coal, and, mingling with the air in the mine, form mixtures which, on the approach of a lighted candle, explode with the most destructive violence. In some coal seams these blowers issue from every hole drilled for the blast. They suddenly come forth from the cavities broken into the coal with the pick, creating a singing noise by the force of the current. Regular currents of the gas may be conveyed away through the 'upcast' shaft to the surface; and for months or years such have been known to pour forth hundreds or thousands of hogsheads of fire damp per minute.

"The great danger is from the sudden opening of the pent-up reservoirs, holding under great pressure immense bodies of gas, disseminated through large areas of coal, or collected in workings long since abandoned. An old working of this nature, filled with waste and fallen fragments, is called a goaf. In some of the collieries a single one of these covers near one hundred acres of surface, and, of course accumulates great quantities of gas. When such bodies are inflamed the whole atmosphere of that portion of the mine explodes, and the coal dust floating through the passages is ignited.

"The mine is like the interior of a fiery furnace; the flames rush through the passages, causing repeated explosions; they rush up the shafts as if issuing from the crater of a volcano. The subterranean walls are shaken as if by an earthquake; movable things, as men, horses, and coal wagons, are hurled through the levels and shot upward through the shafts. Clouds of dust and smoke are poured forth, filling the air above and obscuring the light of the sun.

"The miners in the more distant workings, their lights blown out by the force of the explosion, hasten through the dark passages, encumbered with unaccustomed heaps of rubbish, toward the nearest shaft. Some wander into uncertain alleys, dreading the pestilential choke-damp, which spreads through the mine after these explosions. It overtakes them, and the wretched beings, feeling its power, cease to struggle with their inevitable doom, and deliberately assuming a posture of repose, fall asleep in death."

FIRE-DAMP.

Light carburetted hydrogen is commonly called fire-damp. It was observed in coal mines as early as 1640. Dr. Franklin, in 1774, called the attention of Priestley to an inflammable gas obtained in this country by stirring stagnant pools. It was first accurately described by Drs. Dalton and Thomson in 1811. It is a colorless gas, without taste or smell, and neither of acid nor alkaline properties. Its composition consists of one atom of carbon and two atoms of hydrogen. Its weight, compared with air, is 0.555. Burning bodies immersed in it become extinguished, and it will not support respiration. It is highly inflammable, burning with a yellow flame; but it requires a high heat to ignite it. United with oxygen or atmospheric air, in due proportion, a compound is produced which explodes with the electric spark or the approach of flame.

The mixture of air to produce an explosion may be from seven to fourteen times that of the gas. It is generally very abundant in bituminous coal mines, except drifts or shafts which have a depth of less than one hundred and twenty-five feet.

This gas has about half the density of common air, consequently, it always lies above all other gases or vapors in the mine, and fills all cavities and openings in the roof, or forms a stratum in the higher portions. If it could escape from there it would cause little or no difficulty in mines. Undisturbed it rapidly accumulates, and it does not lose its explosive power until it has been diluted with about twenty-five times its volume of air. Consequently, the only safe preventive from explosion, in a mine where this gas is generated, is thorough ventilation, without which the lives of men, employed in a mine subject to fire-damp, are in constant peril, no matter what other systems of precaution are adopted.

THE SAFETY-LAMP.

Although a great many terrible accidents have been directly due to the careless use of the safety-lamp, yet there is no doubt that it has saved in the aggregate thousands of lives and millions of property, and its invention justly entitles it to rank among the most wonderful achievements of this century. The terrible explosions in the English collieries led many eminent men to investigate the subject very carefully, and among them was Sir Humphrey Davy, who in 1815 produced a lamp enveloped in a thin covering of wire gauze, containing between seven and eight hundred minute apertures to the square inch. Many others have since been invented and are now in general use, and the safety-lamp continues to be the most valuable guard *next to thorough ventilation.*

FIRE-DAMP IN OHIO COLLIERIES.

As has before been stated, fire-damp is not usually found in drifts, or in mines whose depth does not exceed one hundred and twenty-five feet; consequently the great majority of the mines in this State are entirely free from this dangerous compound. In the mines, however, where it does abound, the only remedy is the most complete and systematic ventilation.

I here desire to call attention to part of section 12 of the mining law:

> "In all mines generating explosive gas, the mining boss shall measure the ventilation at least once a week at the inlet and outlet, and also at or near the face of all the entries; and all such measurements shall be reported once a month to the mine inspector."

This section, in common with many others of the act referred to, has no penalty attached for a non-compliance with its requirements, and is almost entirely disregarded.

As has been mentioned, fire-damp being much lighter than air, has a strong tendency to seek the upper portion of the mine, and forms a stratum lying immediately below the roof. Its explosion is immediately followed by an accumulation of carbonic acid gas, familiarly known in mining localities as

BLACK OR CHOKE DAMP.

This was discovered by Dr. Black, in 1757, who called it fixed air. It is composed of one part carbon and two parts oxygen. Its specific gravity as compared with air is as 1.524 to 1, showing it to be about one-half heavier than air.

Nitrogen is the principal element of atmosphere, and is produced in mines by the extraction of the oxygen by combustion. The union of carbonic acid gas with the nitrogen so produced, constitutes what is usually termed "after-damp," and which is deadly in its influence upon animal life. It is this compound of carbonic acid gas and nitrogen which follows immediately after an explosion of fire-damp, and often becomes more destructive to life than the explosion itself, since the effect of explosions is generally to destroy all air-ways and main avenues, and not only prevent the escape of the men, but prevent the currents of air from supplying the necessary volumes to render the after-damp innoxious.

Carbonic acid is produced by the respiration of men and animals, by the combustion of carbon in lamps, and by other causes constantly operating in mines. This gas is fatal to life if mixed with air to the extent of twelve or fifteen per cent. It is the lowest stratum in all mines, as the carburetted hydrogen is the highest. It may be poured almost like water from one jar into another, displacing the air before mixing with it.

It is without color, but has a decidedly sour taste and a pungent odor. Flame is immediately extinguished when it is mixed with air in the proportion of one part to four. Unmixed with air, it is entirely irrespirable; it is rejected with violent spasms of the glottis. In the atmosphere, it is universally diffused in proportion exceeding one thousandth part by measure, even at the greatest height reached by man.

In mines it is a very common thing for the men to continue their work in an atmosphere so foul that their candles or lamps go out, and are then re-lighted from the fire still in the wick by swinging them quickly through the air, when they burn a little while and go out, and are again re-lighted in the same way.

The son of Berthollet, the chemist, who destoyed himself by inhaling the fumes from burning charcoal, writing down his sensations at the time, remarked that the candle was soon extinguished. The lamp continued to burn, and was flickering as he became powerless to record more. *Persons made insensible by inhaling this gas, may be restored by immediately dashing cold water over them.*

Although carbonic oxide gas and sulphureted hydrogen gas are sometimes found in mines, yet they do not sufficiently abound in collieries in this State as to be considered one of the chief elements of danger to our miners. Good ventilation will always prevent their accumulation, even where they have a tendency to form.

Although, as I before mentioned, fire-damp, with its accompanying after-damp, is not to be feared in the great majority of the mines in this State, yet the mere fact of its absence tends to allowing much greater accumulations of carbonic acid gas, (black-damp) than would otherwise exist. The reason is as follows:

Every coal operator is familiar with the fact that fire-damp has caused thousands of explosions in coal mines, entailing the loss of millions of property. Should his mine be subject to fire-damp, he fully understands the danger to which his property is subjected. At any moment some accident may occur that will totally wreck and destroy his colliery; it can scarcely be considered safe a single minute. He is involved in a most risky business venture, with the constant danger of his property being blown to atoms, causing an immediate financial loss. No company in the world would insure his property, with the impending danger hanging over it. Unless some action is quickly taken by him, his property will be lost. *There is one preventive, and only one*, but it is a complete safeguard; this is *thorough ventilation*, keeping a full supply of pure, fresh air constantly sweeping through the mine. Natural forces cannot be depended on in such cases; the safety of the property demands the use of the most improved methods, regardless of cost. Consequently, although the prime reason may have been the protection of the investment, the miners are supplied with pure and wholesome air.

Thus it is found that the deep mines of the State, which are confronted with this danger, have, as a rule, much more thorough ventilation than those which depend on the natural forces. In the former, imperfect ventilation is dangerous not only to the life and health of the miner, but also *to the property of the operator*, while in the latter, although dangerous to the life and deleterious to the health of the miner, *the property of the operator is safe.*

It is thus demonstrated that *when the safety of property is concerned*, the operators take prompt and decisive action, although frequently requiring a large expenditure.

But in by far the greater number of the mines in this State, the safety of the property is not affected by poor or imperfect ventilation, and as a rule ventilation is neglected in these mines, they being allowed to depend too much upon the natural forces, which, in most cases, prove to be wholly inadequate.

Thus the welfare of the miners is treated as a matter of secondary importance. There are some praiseworthy exceptions to the above, but as a general rule, the ventilation of the class of mines referred to is so imperfect as to allow the accumulation of carbonic acid gas, which, though it may not exist in a sufficient proportion to cause immediate death, has a terrible effect on the health of persons subjected to its influences.

Although the following has been quoted in a former report, the picture is so vividly drawn that it is here reproduced. It is from the pen of Dr. Hutchinson, the English chemist, who devoted much time to the study of diseases peculiar to coal miners:

"Although a miner's occupation could not be considered as destructive to health, yet certainly it is not a healthy occupation, and, perhaps, the diseases may be confined almost entirely to the lungs or to the respiratory organs in general (the heart and lungs.) At a distance, you may know a pit-man by his high shoulders and stooping back; at hand, you may know him by his blanched look and wrinkled and bloodless face—the appearance of age in youth. These symptoms are to be attributed to the deleterious quality of the air he breathes, an atmosphere densely and mechanically charged with carbonaceous matter. Upon the surface of the earth, deteriorated air immediately ascends from the person and passes off forever.

"Were this not the case, man would perish for the want of a respirable atmosphere. In the mines this is not the case; the air has to circulate and bend its tortuous course from one lamp, horse, and man to another lamp, horse, and man, and thus supply, probably, one hundred and fifty men, two hundred lights, and thirty horses and mules, before it returns to pass into the general atmosphere.

"The miner works many hours, even all his time, in a kind of *cul de sac*, without a sweeping current of air playing immediately around him; his ambient air is nearly stagnant to all his feelings. This air is densely charged with coal dust, dust in the most palatable form, and his face becomes coated with it; the laborious work of hewing (striking the hard coal with the pick), excites, like other violent exercises, a great respiratory action. He breathes deep and draws into his lungs with avidity this loaded mixture. He breathes thick and is subject to asthma. If he has a consumptive taint he speedily falls a victim to disease; but should he be so fortunate as not to have any claim to this disease, his breathing is rarely natural, that is, inaudible. His blood is not ærated, and thus he presents the appearance already described—a man with a pale face. His conformation is thin, because his nutrition is impeded. The appetite may be good, yet the nourishment is deficient.

"In this close and dirty hole the miner labors and breathes a double quantity of air, therefore, in his ten or twelve hours' working, respiration becomes equal to double that time of ordinary breathing when in a quiescent state. The effects of such an atmosphere are insiduous; gradually he becomes disordered in his breathing, and he is a victim to some chest affection before he is aware of it. Ultimately his lungs are loaded with black matter, solid or fluid, like printers' ink, or common ink, or lamp-black, or charcoal powder—all insoluble and tasteless."

VENTILATION OF MINES.

Thorough ventilation is regarded as the greatest protection the mine can have; and this, when large currents of air are to be made to circulate through the complicated passages of an extensive mine, often to a distance of several miles, requires constant care and attention.

In drift mines it is very common to drive two or more entries through on the coal to the surface; and many of the drift mines depend entirely on the natural forces. In the large mines the double entry system is decidedly preferable, which, when well managed, always affords good air clear up to the head of the entry. This system is rapidly becoming popular, and should be adopted in all well regulated mines. Ventilation is produced by natural temperature, mechanical power, furnace rarefication, and steam-jet propulsion.

Natural ventilation is a most dangerous process, uncertain, without power, and depending on the winds and the temperatures of the atmosphere. In summer, when the heat of the atmosphere is greater than the heat of the mine, the air passes out of the mine at the shaft of the lowest level. In winter, when the atmosphere is colder than the mine, the current of air reserves itself, and goes in at the lowest level. In the fall and in the spring, when the temperatures of the atmosphere and mine approximate, or when the shafts are of equal levels, the ærial balance is destroyed, and the air of the mine becomes stagnant, without the slightest motion. Natural ventilation is, therefore, a most dangerous and indefensible practice, and should never be entirely relied upon to furnish air for the mine.

Mechanical ventilation has been extensively experimented upon, particularly in Europe, and the result of the experiments have fully demonstrated the superiority of the "exhaust-fan" over any rival mechanical appliance. They have for a long time been used with great success in the mines of Europe, and also in the anthracite regions of Pennsylvania, and will eventually be in this State, where they, as yet, have been but little used. The advantages of an exhaust-fan lie principally in the fact that the same engine which operates the shaft cages, can also work the fan; also, the fact of there being much less danger from fire than where the furnace is used. Many good fans have been invented, the "Guibal" generally being preferred.

Furnace Ventilation.—Among the methods for producing artificial ventilation, the furnace is the most generally used in this State. This should be placed back from the bottom of the "upcast" shaft, one hundred or one hundred and fifty feet. The ventilation of a mine by the use of a furnace is on the following general plan:

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Warm air has a very strong tendency to rise, on account of its expansion and consequent lightness; thus, by heating the air in a mine, it immediately rises to the surface through the upcast shaft, which, to increase the draft, sometimes has a stack at its top.

The weight of the colder air, aided by its natural pressure, forces it down the "downcast" shaft with great velocity, to fill the space made vacant by the rarefication and ascension of the heated air. As long as fires are maintained in the furnace this flow of air is continued, and by means of doors and stoppings used for turning the incoming air through the working parts of the mine, good air can be maintained. At many mines, although having good furnaces, keeping up the fires is neglected, thus allowing foul air to accumulate; at others, while the fire may be kept burning in the furnace, doors and stoppings are allowed to get out of order, and, although a sufficient amount of air may be entering the mine, it is not directed in a proper manner through the workings.

PLANS OF WORKING MINES.

Three different plans or systems are in use for extracting the coal, and are called the "long wall," "panel and square," and "pillar and room."

The "long wall" consists of working all the coal as the miner advances, building up solid ways with rocks and timbers behind him through the excavated portions where the roof is allowed to fall. Another manner of working on the "long wall" plan is to complete the entries and air ways before the miners commence to work the coal on the large scale. They then commence "returning," taking out all the coal as they return toward the shaft, leaving the roof to fall behind them. In this way the air courses, and entries are always open and protected by the solid coal.

The "panel and square" plan consist of dividing the area of coal in high squares, leaving between each substantial walls of coal; each separate square is divided into rooms and the pillars are finally withdrawn, allowing the roof of the area composing the square to fall in.

The "pillar and room" plan usually consists of having the entries driven on the face of the coal from which "cross" or "butt" entries are driven generally at right angles from the main entries. From these, in turn, rooms are driven at right angles, being on the face of the coal, where it works easier, leaving sufficient pillars between the rooms to prevent the mass overhead from falling in. When the rooms are exhausted the coal forming the pillars is rescued, as far as may be practicable, before the roof and mass overhead is allowed to fall.

It is useless to attempt to give any general advice in regard to the exclusive adoption of any of these general plans. The depth of the covering; the thickness of the coal; the amount of water; the quality of the strata composing the floor and the roof of the mine; are all to be taken into consideration and it is evident that different surroundings and conditions require different and varied places of working.

CLOSING MINES BY INJUNCTION.

The following is an extract from the mining act:

"SEC. 14. In case any coal mine does not, in its appliances for the safety of the persons working therein, conform to the provisions of this act, or the owner or agent disregards the requirements of this act, any court of competent jurisdiction may, on application of the inspector, by civil action in the name of the state, enjoin or restrain the said owner or agent from working or operating such mine with more than ten miners at once, until it is made to conform to the provisions of this act; and such remedy shall be cumulative, and shall not take the place of or affect any other proceedings against such owner or agent authorized by law for the matter complained of in such action."

In the last annual report of this office was the following:

"The remedy of injunction prevents a mine from working more than ten miners at once, whenever the law is violated as to ventilation, or in some other regards. A mine may have proper ventilation in two-thirds of its working places, yet the force of the mine may be reduced to ten men, and all the properly ventilated places stopped until the bad places are improved.

"Penalties, by fine, or imprisonment, or both, should be attached for neglect or refusal to provide and maintain the amount of air required by the statute, and the remedy of injunction should only be applied in cases of sudden and immediate danger, as where a mine has but one epening, or is liable to inundation of water, or explosion of fire-damp, etc. Enjoining a mine because bad air prevails in any of the working places, punishes the innocent and necessitous miner more than the guilty owner or agent of the mine. This is especially the case during times of low wages and half work, and knowing that complaint against a mine by the inspector will, if proved, result in throwing the miners out of work, the workmen are most averse to testifying in court or even complaining to the inspector."

The necessity for some action in this matter is most urgently recommended.

STRIKES.

There have been no large or long contested strikes during the year at the coal mines in the State. The following are the strikes reported to this office:

BELLAIRE.

A demand by the men for an advance of wages; continued three weeks; the men resumed work at the old wages.

HAMMONDSVILLE, JEFFERSON COUNTY.

A demand for an advance of wages; nine days; result, an advance of fifteen cents per ton.

DOYLESTOWN, WAYNE COUNTY.

The company desired to change the manner of screening coal, which would affect the wages of the men. The men struck; result not known.

SHAWNEE, PERRY COUNTY.

A company, furnishing a furnace with coal, was notified that the coal must be screened over a 1¼-inch screen. The company notified their miners that, as the regular furnace mines had 1¼ inch screens, they must do the same, or the furnace mines reduce to 1¼ inches. The miners quit work, went to the furnace mines, and called a meeting of miners, which resolved to either have the screens reduced or ten cents per ton advance in wages. Result, screens all reduced to 1¼ inches.

MINERAL RIDGE.

A two weeks' strike, to secure a check-weighman, after the court at Warren had decided in favor of the law and the men. Result, returned to work without the check-weighman.

MILL CREEK SLOPES, TRUMBULL COUNTY.

Men asserted their belief that they were not getting weight for coal sent out, and asked to have the scales adjusted. when their tools were ordered to be taken out of the mine. Result not known.

UHRICHSVILLE.

Men struck against a reduction from seventy to sixty cents per ton. Men offered to compromise at a reduction of five cents per ton.

BELLAIRE.

A strike against the size of a screen. Result, a number discharged and left the place, the screen continued, and an advance of twenty cents per 100 bushels.

ZALESKI.

Men struck against a reduction from sixty-five to fifty-five cents per ton; continued ten weeks; result, resumed work at sixty cents per ton.

JACKSON, JACKSON COUNTY.

Men, mining coal for a furnace, being paid their earnings one-fourth cash, three-fourths store goods, objected to the price charged for goods, and proposed that the company should not charge over ten per cent. more for goods than the regular retail stores. This the company refused, and the men struck—that is, about two-thirds of them. The case having been brought into court, the men resumed work.

WADSWORTH, MEDINA COUNTY.

A two weeks' strike in reference to check-weighman; men returned to work satisfied.

CASUALTIES.

List of persons seriously injured during the year ending Nov. 1, 1878:

December 7. Moses A. Lewis, Longstreth's mine, Nelsonville: very badly hurt; thigh and hip broken by fall of hopper.

December 18. John Davis, Silver Creek mine: fall of stone.

December —. Thomas Edwards: by fall of stone.

December 23. Frank Lemon, Silver Creek shaft: was looking in shaft, when cage came down on his head; he was not an employe.

December 4. George Doner, Norton Coal Company: fall of rock.

December 31. Lewis Morris, Longstreth's mine: by fall of coal; head and body.

January 3. James McLong, Brooks's mine: arm broken.

January 3. Elmer McMenney, Longstreth's mine: caught between cars.

January 8. Fred. Heinmiller, Brooks's mine: thigh broken.

January 22. David Davis, Cleveland shaft: cage came down on him while at bottom of shaft; head crushed; dangerously injured.

February 1. Joshua Winn, Averick's shaft, Steubenville: premature blast; badly hurt in face and head.

February 7. Richard Redfern, Brookfield slope: fall of roof; leg broken.

February 26. David P. Davis, Brookfield Coal Company: fall of roof; leg broken.

March 1. David S. Williams, Buffalo Coal Company: fell down shaft.

March 3. Oliver Forteuay: burned by explosion of fire-damp.

March 11. ——— Kruse, Shawnee: fall of slate.

March 19. Henry Bloomer, Powers's bank: fall of roof; seriously injured.

March 23. Wm. Zedeker: plank fell down shaft, and seriously injured him about the head.

March —. George Colvin, Barnesville, Belmont county: injured by fall of roof.

April —. John Gallon, Pennel slope, Mahoning county: car ran away on slope; seriously, if not fatally, injured

April 3. Wm. Harress, Ohio Coal Company's mine: crushed by fall of coal; leg and shoulder crushed.

June 18. Driver at Grove Coal Company's mine: seriously injured by fall of stone.

August 11. John Robinson, Consolidated Company's mine, New Straitsville: fall of slate; injured about head and hips.

October 19. Matthew Cop, Sheffield mine, Athens county: injured while drawing.

October 22. Hugh McGonagle, Straitsville Central mine: injured by fall of slate.

LIST OF FATAL ACCIDENTS.

November 17. Samuel Conrad, Jackson county: fall of roof.

December 13. A. Shannon, Hood mine, Trumbull county: car run down slope.

December 27. James Conners, Milton shaft, Jackson county: crushed to death in shaft; was caught by cage.

February 15. John Merriman, Gore Coal Company: by fall of roof.

February 15. Samuel Ackers: found dead.

February 20. James O'Donnel, Washington mine: killed by shot blown through the pillar.

February 24. George O'Harra, New Philadelphia: crushed to death.

March 29. Thomas Bruster, Bellaire, Belmont county: killed by fall of roof.

April 2. Henry Glass, Rainey's mine, Belmont county: killed by fall of roof.

April 7. John Price, Cleveland shaft, Trumbull county: poisoned by inhaling carbonic acid gas (black damp), or died of heart disease.

April 11. James Gallon, Pennel slope: car ran away on slope.

April —. John Ashton, Crawford slope, Massillon: suffocated.

April 16. Dennis Wilkinson, Cherry Valley mines: fall of slate.

June 19. Thomas B. Broadman, Gore Coal Company: killed by fall of rock.

June —. Richard Kidd, Kidd Works, Belmont county: killed by fall of rock.

July 26. Thomas Darge, Steubenville Coal Company: killed by falling from platform in shaft.

September 9. Jerry Hillyer, Somers & Co.'s works, Carbon Hill, Hocking county: killed by fall of roof.

September 23. Reese Davis, Brookfield: killed by fall of roof.

October 26. A. J. Douglass, Central Mining Company, New Straitsville: killed by fall of slate.

October 31. Michael Murphy, Central Mining Company, New Straitsville: killed by fall of slate.

FINANCIAL STATEMENT.

Statement of traveling and contingent expenses from May 1 to November 14, 1878:

Postage	$12 00
Expressage	50
Care of office	35 00
Kalsomining office	13 00
Furniture for office, including carpet	60 25
Cleaning and repairing carpet	4 00
Lock for office	1 83
Letter box	4 50
Traveling	156 25
Total	$287 33

Paying attorneys' fees, as per request of my predecessor:

Woodworth & Wirt	$260 00
Wilson & Jackson	49 61
G. W. Love	31 20
B. O. Eddy	29 26
Taylor & Jones	66 38
Total	$436 45

The amounts paid to attorneys were only partial payment, exhausting the appropriation.

The large number of mines in this State make it impossible for the Inspector to visit each as often as is frequently desired. My predecessor, in the last annual report of this office, called attention to the fact that it would require two years' time to visit all of the mines in this State. This being the case, it is very desirable that miners and persons interested should consider themselves at liberty to correspond freely with this office.

I have received many anonymous letters purporting to come from miners, which, upon investigatian, I generally found to be from unreliable men who had been discharged, or who had some personal grudge against the parties complained of. I have, therefore, made it a rule to pay no attention to letters which have not the name of the writer attached. This is merely required as a guarantee of good faith, and any communications of this nature will be treated with strict confidence, as many fear discharge in case their names would become known.

In conclusion, I desire to say that the importance of this office is daily increasing, and is rapidly becoming a medium for the exchange of items of interest to both miner and operator.

I remain,
With great respect,
Your obedient servant,
JAMES D. POSTON,
State Inspector of Mines.

LIST OF MINES, TOGETHER WITH NAMES OF OPERATORS, ETC.

ATHENS COUNTY.

Name of mine.	Kind of mine.	Name of coal company.	P. O. address.
Bessemer	Drift	Akron Iron Co.	Nelsonville.
Ogden	"	Ogden Iron Co.	Nelsonville.
Lick Run	"	J. W. Scott	Nelsonville.
Laurel Hill	"	Laurel Hill Coal Co	Bretland.
Section 29	"	W. B. Brooks & Son	Nelsonville.
Coöperative	"	Nelsonville Mining Co	Nelsonville.
Poston's	"	Poston Brothers	Nelsonville.
Longstreth's	"	T. Longstreth	Floodwood.
Floodwood	"	B. B. Sheffield & Bro	Nelsonville.
Hamley's Run	Shaft	G. F. Gould	Athens.
Salina	"	"	Athens.
Chauncey	"		
Big Run*	"	Federal Creek Coal Co	Big Run.
Carbondale	Drift	Carbondale Coal Co	Mineral City.
King's	"	King Brothers	King's Switch.

BELMONT COUNTY.

Barnesville	Shaft	Dawson & Roy	Barnesville.
Franklin	Drift	Stewart & Mehan	Stewardsville.
Kidd's	"	John Kidd	Shields.
Rainey's	"	W. J. Rainey & Co	Cleveland.
Etna	"	Etna Iron and Nail Co	Martin's Ferry.
Helling's	"	Henry Helling	Martin's Ferry.
Ohio City	"	Ohio City Iron and Nail Co	Martin's Ferry.
Belmont Works No. 1	"	Heatherington Brothers	Bellaire.
Belmont Works No. 2	"	" "	Bellaire.
Pittsburgh Works	Slope	Rocherhousen & Sterrett	Bellaire.
Empire	"	Thomas Corcoran	Shawnee.
Weegee	"	P. Shafar & Co	Weegee.
Union Works	"	Union Coal Co	Moundsv'e, W.Va.
Pipe Creek	"	Pipe Creek Coal and Iron Co	Dilley's Bottom.
Barnard's	Drift	W. G. Barnard	Bellaire.
Morgan's	"	E. G. Morgan	Bellaire.

CARROLL COUNTY.

Robertsville No. 1	Drift	Cleveland Iron Co	Salineville.
Robertsville No. 2	"	" "	Salineville.
Brown's Strip Vein*	"	Matthew Brown	Salineville.
Brown's Big Vein*	"	"	Salineville.
Dutchen & Davis	"	Dutchen & Davis	Salineville.
Tunnell Hill	Shaft	J. C. Card	Cleveland.
Welsh Mines	Slope	McDowell & Pratt	Mineral City.

COLUMBIANA COUNTY.

Washingtonville No. 1	Drift	Cherry Valley Iron Co	Leetonia.
Washingtonville No. 2	"	" "	Leetonia.
Leetonia Slope	Slope	" "	Leetonia.
Grafton	Shaft	Grafton Iron and Coal Co	Leetonia.
Empire	Drift	Ohio and Pennsylvania Coal Co.	Salineville.
Hayes	"	John Hayes	Salineville.
Farmer's	"	James Farmer	Salineville.

COLUMBIANA COUNTY—Continued.

Name of mine.	Kind of mine.	Name of coal company.	P. O. address.
Hartford	Drift	O. & P. Coal Co.	Salineville.
Rockville	"	"	Salineville.
O. and P.	"	"	Salineville.
Granage & Anderson	"	Manufacturers' Coal Co.	Salineville.
Foster	"	Harding & Sharp	Salineville.
Hussey Hollow	"	O. & P. Coal Co.	Salineville.
Truesdale	"	Truesdale Coal Co.	Salineville.
Robins'	"	New Lisbon Coal Co.	New Lisbon.
Foster Mine	"	Shields Coal Co.	Teegarden.
Rose Mine	"	Thomson & Coleman	Teegarden.
State Line	"	State Line Coal Co.	East Palestine.
Prospect Mines	"	Prospect Coal Co.	East Palestine.
O. and P.	"	O. & P. Coal Co.	Salineville.
Wolf Run	"	A. Armstrong	Teegarden.
		COSHOCTON COUNTY.	
Union	Drift	Union Coal and Mining Co.	Coshocton.
Blaen Nant	"	David Jones	Coshocton.
Rock Run	"	Rock Run Coal Co.	Coshocton.
Summit	"	Franklin and Coalport Coal Co.	Coshocton.
Coshocton	"	Coshocton Coal Co.	Coshocton.
Diamond	"	Diamond Coal Co.	Coshocton.
Cunesville	"	Ressler & Co.	Newark.
Pen Twyn	"	Pen Twyn Coal Co.	Coshocton.
Home	"	Home Coal Co.	Coshocton.
		GUERNSEY COUNTY.	
Scott's	Drift	Scott Coal and Salt Works Co.	Cambridge.
Cambridge	"	Cambridge Coal and Mining Co.	Cambridge.
Central	Shaft	William Norris	Cambridge.
Nicholson	Drift	Ohio Coal Co.	Marietta.
Guernsey	"	Guernsey Mining Co.	Cambridge.
		GALLIA COUNTY.	
Leadington	Drift	Leadington Coal Co.	Cheshire.
Cheshire	"	Cheshire Coal Works Co.	Cheshire.
		HOCKING COUNTY.	
Section 19	Drift	W. B. Brooks & Son	Nelsonville.
Hayden's	"	Peter Hayden	Haydenville.
Gore	"	Thomas Iron Co.	Gore.
Monday Creek	"	Monday Creek Iron Co.	Cleveland.
Carbon Hill	"	Somers & Co.	Columbus.
		HOLMES COUNTY.	
Hardy*	Drift	Hardy Coal Co.	Millersburg.
Myers	"	Bowen Bros.	Millersburg.
		HARRISON COUNTY.	
Philadelphia	Drift	Philadelphia Coal Mining Co.	Stati

JEFFERSON COUNTY.

Name of mine.	Kind of mine.	Name of coal company.	P. O. address.
Market Street	Shaft	Steubenville Coal Mining Co.	Steubenville.
Stony Hollow	"	" "	Steubenville.
Gravel	"	" Furnace and Coal Co.	Steubenville.
Everick	"	Ohio and Penn. Coal Co.	Steubenville.
Boreland	"	Swift's Iron and Steel Works	Steubenville.
Rolling Mill	"	Spaulding, Woodward & Co.	Steubenville.
Mingo	"	Mingo Iron Co.	Mingo.
La Grange	"	La Grange Coal Co.	Phillipsburg.
Rush Run	"	Kaminsky & Ramsey	Rush Run.
Bustard	"	Steubenville Coal and Coke Co.	Steubenville.
Alikana	"	Bell & Co.	Steubenville.
Irondale	Drift	Morgan Iron Co.	Irondale.
Hammondsville	"	Hammondsville Coal and Coke Co.	Hammondsville.
Wallace	Shaft	Wallace & Sons	Hammondsville.
Diamond	Drift	"	Hammondsville.

JACKSON COUNTY.

Name of mine.	Kind of mine.	Name of coal company.	P. O. address.
Wellston	Shaft	Wellston Coal and Iron Co.	Wellston.
Milton	"	Milton Furnace and Coal Co.	Wellston.
Star	"	Star Furnace Co.	Jackson.
Tropic	"	Tropic "	Jackson.
Orange	"	Orange Iron Co.	Jackson.
Globe	Slope	Globe "	Jackson.
Huron	Shaft	Huron "	Jackson.
Erie	"	Erie "	Jackson.
Jackson Hill	Drift	Price Bros.	Jackson.
Petrea	"	Petrea Coal Co.	Jackson.
Kitrick	"	T. M. Kitrick	Jackson.

LAWRENCE COUNTY.

Name of mine.	Kind of mine.	Name of coal company.	P. O. address.
Sheridan	Drift	Sheridan Coal and Iron Co.	Sheridan.
Hanging Rock	"	Means, Kile & Co.	Ironton.
Bellford	"	Norton Bros. & Co.	Ironton.
Old Mill	"	Iron and Steel Co.	Ironton.
Lawrence	"	Lawrence	

MEDINA COUNTY.

Name of mine.	Kind of mine.	Name of coal company.	P. O. address.
Wadsworth	Slope	Wadsworth Coal Co.	Akron.
Diamond	"	Humphrey & Coleman	Akron.

MAHONING COUNTY.

Name of mine.	Kind of mine.	Name of coal company.	P. O. address.
Foster	Shaft	Foster Coal Co	Youngstown.
Osburn	"	Andrews Bros	Youngstown.
Kyle	"	Kyle Coal Co	Youngstown.
Wells	"	Wick & Wells	Youngstown.
Austin	"	Tod, Wells & Co	Mineral Ridge.
Harris	"	Harris & Mauer	Mineral Ridge.
McKennie	"	Warner & Co	Mineral Ridge.
Junction	"	Junction Coal Co	Mineral Ridge.
Fulks	Slope	Fulk Coal Co	Mineral Ridge.
Pennel	"	New Lisbon Coal Co	Youngstown.
Haroff	"	Haroff Coal Co	Youngstown.
Thorn Hill	"	Powers & Arms	Youngstown.
Packard	"	Packard Coal Co.	Youngstown.
Powers	"	Powers Coal Co	Youngstown.
Holland	Drift	Moore & Co	Youngstown.
Jackson	Slope	Jackson Coal Co.	Youngstown.
Reno	"	Powers Coal Co.	Youngstown.
Mahoning	"	Mahoning Coal Co	Youngstown.
Walters	Drift	Walters & Co	Washingtonville.

Muskingum County.

Name of mine.	Kind of mine.	Name of coal company	P. O. address.
Zanesville	Drift	John Marpool	Ranesville.
Del Carbo	"	Consolidated Coal Co	Roseville.
Muskingum	"	Muskingum Valley Coal Co	Roseville.
Matthews	"	Lewis Matthews	Zanesville.
Monitor	Shaft	Cowell, Harris & Co	Zanesville.
Locust Grove	Drift	James Owens	Putnam.
Harper	"	James Morrison	Putnam.
Coal Ridge	Drift	Orin Ballou	Zanesvile.
Taylorsville	"	G. Scarval	Philo.
Crow Run	"	Stone & Deral	Cedar Run.
Blue Rock	"	James Patterson	Blue Rock.
Meigs County.			
Ohio	Shaft	Ohio Coal Co	Racine.
Syracuse	"	Syracuse Coal and Salt Co	Syracuse.
"	Slope	H. G. Daniels	Syracuse.
Pamunky	Drift	Pomeroy Coal Co	Pomeroy.
Minersville	"	" "	Pomeroy.
Excelsior	"	" "	Pomeroy.
Pencreek	"	" "	Pomeroy.
Dabney	"	" "	Pomeroy.
Williams	"	Evan Williams	Minersville.
Coal Ridge	"	Coal Ridge Salt Co	Pomeroy.
Buckeye	"	Buckeye Salt Co	Pomeroy.
Middleport	"	Middleport Salt Co	Middleport.
Charter Oak	"	S. M. Pomeroy	Pomeroy.
Noble County.			
Dexter	Drift	Ohio Coal Co	Marcella.
Perry County.			
Central	Drift	Straitsville Central Mining Co	New Straitsville.
Old Mine	"	J D. Doe & Co	New Straitsville.
Plummer Hill	"	Straitsville Coal Co	New Straitsville.
Troy	"	Mitchell, Kincaid & Co	New Straitsville.
Wright's	"	J. H. Lucker	New Straitsville.
Mungen's	"	Consolidated Coal Co	New Straitsville.
Patterson	"	Patterson Coal Co	New Straitsville.
Upson	"	Union Coal Co	Shawnee.
Shield's	"	Newark Coal and Iron Co	Shawnee.
New York	"	New York and Straitsville Coal Co.	Shawnee.
Lyonsdale	"	Straitsv. and Cannel Coal C. of N.Y.	Shawnee.
Furnace	"	Furnace Coal Co	Shawnee.
Shawnee Valley	"	Shawnee Valley Coal Co	Shawnee.
Taygue's	"	M. & P. Taygue	McLuny's.
McLuny	"	H. Jones & Co	McLuny's.
Tunnel Hill	"	Tunnel Hill Coal Co	New Lexington.
Selby	"	Selby Mining Co	New Lexington.
Wales's	"	Wales, Nugent & Co	New Lexington.
Crookville	"	Palmer & Haworth	Crooksville.
McCuneville	"		
Brilliant	"	J. E. Payne & Co	McCuneville
Black Diamond	"	Black Diamond Coal Co	McCuneville.
O. K	"	O. K. Coal Co	McCuneville.
Southern Ohio	"	Southern Ohio Coal Co	Maholm.
Anderson's	"	W. D. Anderson	Maholm.
Ferrara	"	James Black	Moxahala.
Brindebal's	"	J. Brindebal	Moxahala.
Moxahala	"	Moxahala Iron Co	Moxahala.

JEFFERSON COUNTY.

Name of mine.	Kind of mine.	Name of coal company.	P. O. address.
Market Street	Shaft	Steubenville Coal Mining Co.	Steubenville.
Stony Hollow	“	“ “	Steubenville.
Gravel	“	“ Furnace and Coal Co.	Steubenville.
Everick	“	Ohio and Penn. Coal Co.	Steubenville.
Boreland	“	Swift's Iron and Steel Works	Steubenville.
Rolling Mill	“	Spaulding, Woodward & Co.	Steubenville.
Mingo	“	Mingo Iron Co.	Mingo.
La Grange	“	La Grange Coal Co.	Phillipsburg.
Rush Run	“	Kaminsky & Ramsey	Rush Run.
Bustard	“	Steubenville Coal and Coke Co.	Steubenville.
Alikana	“	Bell & Co.	Steubenville.
Irondale	Drift	Morgan Iron Co.	Irondale.
Hammondsville	“	Hammondsville Coal and Coke Co.	Hammondsville.
Wallace	Shaft	Wallace & Sons	Hammondsville.
Diamond	Drift	“	Hammondsville.
		JACKSON COUNTY.	
Wellston	Shaft	Wellston Coal and Iron Co.	Wellston.
Milton	“	Milton Furnace and Coal Co.	Wellston.
Star	“	Star Furnace Co.	Jackson.
Tropic	“	Tropic “	Jackson.
Orange	“	Orange Iron Co.	Jackson.
Globe	Slope	Globe “	Jackson.
Huron	Shaft	Huron “	Jackson.
Erie	“	Erie “	Jackson.
Jackson Hill	Drift	Price Bros.	Jackson.
Petrea	“	Petrea Coal Co.	Jackson.
Kitrick	“	T. M. Kitrick	Jackson.
		LAWRENCE COUNTY.	
Sheridan	Drift	Sheridan Coal and Iron Co.	Sheridan.
Hanging Rock	“	Means, Kile & Co.	Ironton.
Bellford	“	Norton Bros. & Co.	Ironton.
Old Mill	“	Iron and Steel Co.	Ironton.
Lawrence	“	Lawrence	
		MEDINA COUNTY.	
Wadsworth	Slope	Wadsworth Coal Co.	Akron.
Diamond	“	Humphrey & Coleman	Akron.
		MAHONING COUNTY.	
Foster	Shaft	Foster Coal Co	Youngstown.
Osburn	“	Andrews Bros	Youngstown.
Kyle	“	Kyle Coal Co	Youngstown.
Wells	“	Wick & Wells	Youngstown.
Austin	“	Tod, Wells & Co	Mineral Ridge.
Harris	“	Harris & Mauer	Mineral Ridge.
McKennie	“	Warner & Co	Mineral Ridge.
Junction	“	Junction Coal Co	Mineral Ridge.
Fulks	Slope	Fulk Coal Co	Mineral Ridge.
Pennel	“	New Lisbon Coal Co	Youngstown.
Haroff	“	Haroff Coal Co	Youngstown.
Thorn Hill	“	Powers & Arms	Youngstown.
Packard	“	Packard Coal Co	Youngstown.
Powers	“	Powers Coal Co	Youngstown.
Holland	Drift	Moore & Co	Youngstown.
Jackson	Slope	Jackson Coal Co	Youngstown.
Reno	“	Powers Coal Co	Youngstown.
Mahoning	“	Mahoning Coal Co	Youngstown.
Walters	Drift	Walters & Co	Washingtonville.

MUSKINGUM COUNTY.

Name of mine.	Kind of mine.	Name of coal company	P. O. address.
Zanesville	Drift	John Marpool	Ranesville.
Del Carbo	"	Consolidated Coal Co	Roseville.
Muskingum	"	Muskingum Valley Coal Co	Roseville.
Matthews	"	Lewis Matthews	Zanesville.
Monitor	Shaft	Cowell, Harris & Co	Zanesville.
Locust Grove	Drift	James Owens	Putnam.
Harper	"	James Morrison	Putnam.
Coal Ridge	Drift	Orin Ballon	Zanesvile.
Taylorsville	"	G. Scarval	Philo.
Crow Run	"	Stone & Deral	Cedar Run.
Blue Rock	"	James Patterson	Blue Rock.

MEIGS COUNTY.

Ohio	Shaft	Ohio Coal Co	Racine.
Syracuse	"	Syracuse Coal and Salt Co	Syracuse.
"	Slope	H. G. Daniels	Syracuse.
Pamunky	Drift	Pomeroy Coal Co	Pomeroy.
Minersville	"	" "	Pomeroy.
Excelsior	"	" "	Pomeroy.
Pencreek	"	" "	Pomeroy.
Dabney	"	" "	Pomeroy.
Williams	"	Evan Williams	Minersville.
Coal Ridge	"	Coal Ridge Salt Co	Pomeroy.
Buckeye	"	Buckeye Salt Co	Pomeroy.
Middleport	"	Middleport Salt Co	Middleport.
Charter Oak	"	S. M. Pomeroy	Pomeroy.

NOBLE COUNTY.

Dexter	Drift	Ohio Coal Co	Marcella.

PERRY COUNTY.

Central	Drift	Straitsville Central Mining Co	New Straitsville.
Old Mine	"	J. D. Doe & Co	New Straitsville.
Plummer Hill	"	Straitsville Coal Co	New Straitsville.
Troy	"	Mitchell, Kincaid & Co	New Straitsville.
Wright's	"	J. H. Lucker	New Straitsville.
Mungen's	"	Consolidated Coal Co	New Straitsville.
Patterson	"	Patterson Coal Co	New Straitsville.
Upson	"	Union Coal Co	Shawnee.
Shield's	"	Newark Coal and Iron Co	Shawnee.
New York	"	New York and Straitsville Coal Co.	Shawnee.
Lyonsdale	"	Straitsv. and Cannel Coal C. of N.Y.	Shawnee.
Furnace	"	Furnace Coal Co	Shawnee.
Shawnee Valley	"	Shawnee Valley Coal Co	Shawnee.
Taygue's	"	M. & P. Taygue	McLuny's.
McLuny	"	H. Jones & Co	McLuny's.
Tunnel Hill	"	Tunnel Hill Coal Co	New Lexington.
Selby	"	Selby Mining Co	New Lexington.
Wales's	"	Wales, Nugent & Co	New Lexington.
Crookville	"	Palmer & Haworth	Crooksville.
McCuneville	"		
Brilliant	"	J. E. Payne & Co	McCuneville
Black Diamond	"	Black Diamond Coal Co	McCuneville.
O. K	"	O. K. Coal Co	McCuneville.
Southern Ohio	"	Southern Ohio Coal Co	Maholm.
Anderson's	"	W. D. Anderson	Maholm.
Ferrara	"	James Black	Moxahala.
Brindebal's	"	J. Brindebal	Moxahala.
Moxahala	"	Moxahala Iron Co	Moxahala.

PORTAGE COUNTY.

Name of mine.	Kind of mine.	Name of coal company.	P. O. address.
Atwater Slope	Slope	Atwater Coal Co	Atwater.
		STARK COUNTY.	
Sippo Coal Co	.. .. ..	Russell, Davis & Co	
Fulton	Slope	Fulton Coal Co	Canal Fulton.
Buckeye	"	Buckeye Coal Co	Canal Fulton.
Crawford	Shaft	Crawford Coal Co	Massillon.
Crawford	Slope	" "	Massillon.
Willow No. 1	"	Rhodes & Co	Massillon.
Willow No. 2	Shaft	" "	Massillon.
Williamson	"	Howells, Lee & Co	Massillon.
Maple Grove	"	Massillon Coal and Mining Co	North Lawrence.
Aberdave	"	Youngstown Coal Co	Massillon.
Jacobs	"	Rhodes Coal Co	Massillon.
Grove	"	Grove Coal Co	Massillon.
Massillon Coal Co	"	Massillon Coal Co	Massillon.
Staeffer	Drift	J. P. Burton	Massillon.
Warrington	Shaft	Warrington Coal Co	Massillon.
Brookfield	"	H. Foultz	Massillon.
Pigeon Run	"	Lee, Howells & Co	Massillon.
Lawrence	"	J. P. Burton	Massillon.
Foultz's	Slope	Massillon City Coal Co	Massillon.
Willow No. 3	"	Rhodes & Co	Massillon.
		SUMMIT COUNTY.	
Crawford's	Drift	Crawford & Co	Akron.
Franklin	Slope	Franklin Coal Co	Akron.
Summit	"	Summit Mine Coal Co	Akron.
Brewster Slope	"	Brewster Coal Co	Akron.
Brewster Drift	Drift	" "	Akron.
Brewster Bros	Slope	Brewster Bros	Middlebury.
Middlebury Shaft	Shaft	Middlebury Coal Co	Middlebury.
Johnson Shaft	"	Johnson Coal Co	Middlebury.
Dennison	Drift	Dennison Coal Co	Sherman.
Nemisilla	Slope	Nemisilla Coal Mining Co	Cleveland.
Norton's	"	Norton Coal Co	Sherman.
		TUSCARAWAS COUNTY.	
Block Vein*	Drift	Block Vein Colliery Co	Dennison.
Dennison	"	Dennison Colliery Co	Dennison.
Andraes Mine	"	S. W. Andraes & Co	Urichsville.
Stillwater	"	Tuscarawas Valley Coal Co	New Philadelphia.
Syracuse	"	Syracuse Coal Co	Urichsville.
Pike Run	"	Tuscarawas Valley Coal Co	New Philadelphia.
Rich Hill	Shaft	Rich Hill Coal Co	Waynesburgh.
Walton Ridge	Drift	Buckeye Coal and Coke Co	New Philadelphia.
Port Washington	"	Glasgow and Port Washington Iron Co	Port Washington.
Uhrichsville Shaft*	Shaft		
		TRUMBULL COUNTY.	
Vienna‡	Shaft	Vienna Coal and Iron Co	Youngstown.
Tyler	Slope	C. H. Andrews & Bro	Youngstown.
Halliday	"	Halliday Coal Co	Youngstown.
Hood	"	Arms & Wick	Youngstown.
Sodom	"	McCurdy Coal Co	Youngstown.
Church Hill Slope	"	Church Hill Coal Co	Youngstown.
Church Hill Shaft	Shaft	Niles Coal Co	Youngstown.

TRUMBULL COUNTY—Continued.

Name of mine.	Kind of mine.	Name of coal company.	P. O. address.
Kline	Slope	Briar Hill Iron Co	Youngstown.
Moore*	"	Moore Coal Co	Youngstown.
Shenango	"	Shenango Coal Co	Wheatland, Pa.
Brookfield	"	Brookfield Coal Co	Sharon, Pa.
Burnett	"	Burnett Coal Co	Youngstown.
Mahoning	"	Mahoning Coal Co	Youngstown.
Cleveland	Shaft	Payne, Newton & Co	Cleveland.
Ashland	Slope	Waro, Warner & Co	Mineral Ridge.
Weathersfield	Shaft	H. A. Wick & Co	Mineral Ridge.
Cambria	Slope	W. Williams & Co	Mineral Ridge.
Love	"	Andrews & Hitchcock	Youngstown.
Williams	Shaft	D. Williams & Co	Hubbard.
Winfield	Slope	Winfield Coal Co	Mineral Ridge.
Curtis Hill	Drift	Curtis & Boyee	Sharon, Pa.
		VINTON COUNTY.	
Vinton Shaft	Shaft	Bancroft & Rader	Vinton Station.
Coalmont	Drift	Zaleski Coal Co	Zaleski.
Moonville Mine	"	Richard Coe	Moonville
Buckeye	"	King Bros	King's Switch.
		WAYNE COUNTY.	
Fairview	Shaft	J. P. Burton	Massillon.
Silver Creek No. 1	Drift	Silver Creek Mining Co	Doylestown.
Silver Creek No. 2	Shaft	" "	Doylestown.
		WASHINGTON COUNTY.	
Washington *	Drift	Washington	Youngstown.
Cliff Mines	"	G. W. Lyne	Coal Run.
Macksburg	"	Ohio Coal Co	Marietta.

* Idle. † Drowned. ‡ Worked out.

SUPPLEMENT.

INDUSTRIAL ARBITRATION.

The following bill, to establish courts of conciliation, has been introduced in the Ohio Senate:

S. B. No. 326—Mr. Dungan, of Jackson County.

A BILL

To establish courts of conciliation in each of the counties of this state, and defining the duties thereof.

Section 1. *Be it enacted by the General Assembly of the State of Ohio,* That on the petition of not less than fifty artisans and workingmen, electors of the county, the court of common pleas, or any judge thereof, shall appoint an elector named in such petition, as the presiding judge of a court, to be styled a court of conciliation, who shall hold his office for the term of three years, and who shall take an oath of office similar to that taken by other judicial officers.

Sec. 2. The compensation of such presiding judge shall be three dollars per diem for each day actually employed in the trial of matters submitted to his court, to be paid out of the county treasury upon the warrant of the county auditor, countersigned by a judge of the court of common pleas.

Sec. 3. Said presiding judge shall have authority upon complaint or notice in writing, signed by not less than six reputable men interested in such matter, that a difficulty or difference has arisen, or threatens to arise between any corporation, firm, company, or person employing labor, and the employes thereof, or between such different corporations, firms, companies, or persons, or between the employes of one corporation, firm, company, or person, and the employes of any other, in relation to wages, time, terms, conditions, weights or measures, screens, prices of supplies, drawbacks, dockage, or any other question or matter of dispute disturbing, or threatening to disturb, the harmonious relations of any such parties, to take jurisdiction of such matters or questions, and upon security for the costs of such proceedings, and the filing with him of a detailed, concise statement of the points, matters, and questions to be submitted, he shall issue a notice, to be served as a summons in cases in the court of common pleas, upon all parties and persons known to be interested in such controversy, giving five days' notice of the filing of such statement of differences; and the persons filing such statement may select an associate judge, and the corporation, firm, company, or individual interested adversely to the persons filing the same, may also select an associate judge of such court of conciliation to act in the determination of the case made by the statement filed by the complainants, and the compensation of such associate judges shall be the same as that of presiding judge of such court, to be paid equally by the plaintiff and defendants in such case.

SEC. 4. Such court of conciliation, when thus constituted, shall proceed without delay to inquire into the matters contained in said statement, and may subpœna witnesses, and shall have the same powers and be governed by the legal rules of evidence as courts of common pleas to enforce order and obedience to its orders and decrees.

SEC. 5. The sheriff of the county shall be ex-officio the sheriff of said court of conciliation, and during the sitting of such court he shall attend in person or by deputy.

SEC. 6. The place of holding such court shall be designated by the presiding judge thereof, and he shall give the sheriff written notice of the time and place of holding such court.

SEC. 7. The decisions, findings, or orders of said court of conciliation may be made a rule of any court of record in such county, and upon being so made a rule of any court, shall be final and conclusive (subject only to proceedings in error to be taken within twenty days after such rule has been entered), and shall be enforced as like orders, decisions, or findings of courts of record.

SEC. 8. Whenever any corporation, firm, or company, or person employing laborers, or other workmen, shall by a written agreement with such laborers or other workmen, provide for the reference of any dispute or controversy as to wages or conditions of employment, to an arbitration board, to be composed as set forth in such agreement, such agreement shall be of binding force and efficacious between the parties thereto, and such board shall take jurisdiction of any matter provided for in said agreement upon the complaint of any party to such agreement, and when any such dispute is referred to such arbitration board as provided in such agreement, the decision of such board shall be as final and conclusive as if made by the judges of a court of conciliation as hereinbefore provided, and the judgment and findings of such arbitration board may be made a rule of court of any court of record in the county, and enforced as a judgment or decree of such court in other cases.

SEC. 9 This act shall take effect and be in force on and after its passage.

Of this bill, P. F. Fitzpatrick, Esq., President of the Iron Molders' Union of N. A., says:

"In my opinion the passage of S. B. 326 would result in much good by preventing strikes, sometimes of long duration. The working classes would always be willing to submit to such a court. The molders have always been in favor of arbitration, and I hope the bill may pass."

A letter from P. M. Arthur, Grand Chief Engineer of the Brotherhood of Locomotive Engineers, says:

"I have examined S. B. 326, and am heartily in favor of it, to prevent a recurrence of what the past two years have witnessed."

Letters have also been received from the Lake Shore shops, and many coal miners, urging the creation of a court of arbitration, and expressing satisfaction with this bill.

ARBITRATION IN FRANCE AND ENGLAND.

The following address was delivered before the manufacturers and workingmen of Pittsburgh and vicinity, January 25, 1879, upon the invitation of the Chamber of Commerce of Pittsburgh. The investigations which serve as its basis were made during the summer of 1878, the author having been appointed by His Excellency, John F. Hartranft, Governor of Pennsylvania, a special commissioner to investigate, on behalf of the State, the form, practical workings, and results of the various systems of arbitration in operation in England and France, and to report on the same. This report has been made and will be published by the State.

The intention of this address is not to give details of the various plans of arbitration and conciliation, but simply the results of the system, and to urge its adoption in this country. It has been thought best, however, to print a code of rules. The rules of the Board of Arbitration and Conciliation for the North of England Manufactured Iron Trade have been selected as being those of a trade in which Ohio is especially interested.

MR. PRESIDENT AND GENTLEMEN: I confess that it is with no small degree of satisfaction that I respond to the very courteous invitation of your Chamber of Commerce to explain to you the practical workings of industrial arbitration in France and England. Few communities have a greater interest than this in the peaceful solution of the questions that vex and harass industrial progress. The securing and continuance not only of peaceful but of cordial relations between employers and employed, is of the utmost importance. On these depend largely the continued and increasing production of your great staple manufactures, the safety and profit of your invested capital, and, above all, the welfare of that large army of skilled workmen who have here gathered, and whose strength and cunning, united with capital's energy and judgment, have elevated labor, have conserved and multiplied capital, and have made these twin cities, "these brunettes of labor," as one of your members has so happily termed them, to occupy a proud pre-eminence among the great centers of American industry.

While the present constitution of industrial society exists, differences will arise between employer and employed. These differences will relate mainly to rates of wages, but not entirely. The relations of employer and employed give rise, not only to constantly recurring, but constantly varying questions. There are customs of the trade and the workshop; there are rules which either party may seek to establish in accordance with what it considers its interest and, justly or not, its right, and there are those questions which that eminent English advocate of arbitration, Mr. Rupert Kettle, so felicitously terms "matters of sentiment," quarrels concerning which are often the most senseless, but at the same time the most bitter of trade disputes. May I not also add that there are considerations connected with labor, and its rights and duties, of a far different and a higher nature than those that can be compassed by buying and selling, and which of all questions must not be ignored in a discussion of this character.

Natural law, we are told, will adjust these relations and harmonize these differences; but natural law is slow in its operations, and men may starve and industry be hopelessly crippled while we wait its outcome. Industrial questions demand at times immediate settlement, and for this I know at present but two methods—strikes and lock-outs, or arbitration and conciliation. For the first of these methods I know of no advocates. Men who use them condemn them bitterly, and regret the necessity that, to them, seems to demand their employment. They are of themselves no more fit subjects for approving words than wars or pestilence. I do not mean that strikes and lock-outs are never justifiable. At times they seem unavoidable, but to adopt them, or to advocate their adoption as an approved method of settling industrial questions, is to invite the aid of powder to quench fire.

The other method is arbitration and conciliation. As a principle it has everything in its favor. It has been adopted in many branches of business to avoid expensive and tedious litigation. Arbitration clauses are found in articles of partnership, in policies of insurance, in leases, in building contracts. Why should it not be adopted to avoid those most serious and expensive litigations, strikes and lock-outs?

The question, Have arbitration and conciliation been successful in harmonizing the relation of capital and labor where they have been fairly tried? is a very pertinent one just here. I will try to answer this question by showing you what they have accomplished in France and England.

First, however, I should say that arbitration and conciliation are not the same. Arbitration deals with the larger questions of trade, conciliation with the smaller. Arbitration with the whole trade, conciliation oftener with the individuals. Conciliation is not formal; it does not attempt to sit in judgment and decide in a given case what is right and what is wrong, but its efforts are, in a friendly spirit, to adjust differences by inducing the parties to agree themselves It removes causes of dissensions and prevents differences from becoming disputes by establishing a cordial feeling between those who may be parties to the same. Arbitration, on the other hand, is formal. It sits in judgment. It implies that matters in dispute by mutual consent, or by previous contract, have been submitted to arbiters, and an umpire whose decision is final and binding on both parties. Bearing this distinction in mind, we can better understand the results that have attended the establishment of boards of arbitration and conciliation in France and England.

Industrial arbitration and conciliation had their origin in France early in the present century. The system established was the outgrowth of the trade guilds which had existed in that country and regulated trade matters, in some cases from the middle ages. These were abolished during the last days of the monarchy of Louis XVI, a time when the constitution of industrial as well as political society was being overturned. After a few years of imperfect legislation, in 1806, at the request of the workingmen of Lyons, and by command of the First Napoleon, courts of arbitration and conciliation were established by law. These, with some slight modification, have continued until the present, under the title of "*Conseils des Prud, hommes.*" These councils are judicial tribunals, constituted under authority of the Minister of Commerce, through the chambers of commerce, which are established at important trade-centers of that country. They are composed of an equal number of employer and workingmen members, each class electing its own representatives, with a president and vice-president named by the government. The authority of these councils extends to every conceivable question that can arise in the workshop, not only between the workman and his employer, but between the workman and his apprentice or his foreman. There is but one question they cannot settle—future rates of wages; but even this can be done by mutual agreement. Arbitration is compulsory upon the application of either, and the decisions of the court can be enforced the same as those of any other court of law.

The workings of these courts have been very beneficial to French industry, especially in conciliation, by which more than ninety per cent. of all cases brought before the tribunals are settled. In 1847 the sixty-nine councils then in existence had before them 19,271 cases, of which 17,951 were settled by conciliation in the Private Bureau, 519 more by open conciliation, and in only 529 cases was it necessary to have formal judgment. In 1850, of 28,000 cases 26,800 were settled by conciliation. There were, at the close of 1874, 112 councils in France. This is a most satisfactory showing, but it falls far short of expressing the great benefit these councils have been to French industry, especially in removing causes of difference or in preventing them from growing into disputes.

As beneficial as these have been to France, the method is not applicable to this country, in my judgment. In the first place we have not the requisite organization to carry it out. Again the councils do not consider future rates of wages, the most prolific source of labor troubles with us; and in the third place the compulsory feature seems to be especially obnoxious to both employer and employed.

Though legal and compulsory arbitration and conciliation have been so successful in settling trade disputes in France for nearly a century, they have found no lodgment in England, though a law in some respects similar to the French law has been, since 1824, and is to-day, on her statute books. This law, with one passed in 1867 and another in 1872, have not, in a single instance, certainly not lately, been used. Arbitration, as practiced in England to-day, is purely voluntary. The boards have no sanction of law nor a legal existence. There is no forced submission, nor is there any power, except a man's sense of honor, public opinion, or the aggregate honor of the unions or the employers' associations, to enforce the acceptance of the awards, and to the honor of the parties involved, be it said, these have in most cases been found sufficient. This is one of the grandest features of industrial arbitration. To see trades of the extent of the North of England iron trade, with their millions of invested capital and their vast armies of workmen, voluntarily submit their troubles to the decision of reason, and then abide by that decision, is a most happy augury for the future. It is not so difficult to submit a case to arbitration, as there is always a feeling that perhaps it is best to yield, or that the case will go in one's favor; but when, as in scores of cases has happened in England, the decision has been adverse to the men, to see thousands, forced only by their sense of honor, quietly accept the awards of the board, is a sight that has more of promise for the future of industry than ten thousand victories forced by a strike or a lock-out.

The first voluntary permanent board of arbitration and conciliation was established in the hosiery and glove trade of Nottingham, England, in 1860, mainly through the efforts of Mr. A. J. Mundella, a manufacturer, and at present M. P. for Sheffield. The history of the relations of capital and labor in this trade, for 150 years before the establishment of this board, is one of the most disagreeble chapters of English industrial records. It was in this trade that the crime known as Luddism, or machine breaking, had its origin, which, by a special act of Parliament, was made punishable with death, and as late as 1816 six persons suffered this penalty. From this time, though outrages against person and property ceased, strikes and lock-outs, with the attendant suffering and consequent bitterness, seemed the normal state of the trade. In 1860 three strikes occurred, the third lasting eleven weeks; and it was at the close of this that the board of arbitration was formed. To prevent an entire lock-out of all branches of the trade, upon the suggestion of Mr. Mundella the workmen were invited to a conference. T
came, and after three days agreed to settle the strike in progress and to establi
of arbitration and conciliation to settle future differences. From that

eighteen years, there has not been a general strike in this trade. This board has regulated all the fluctuations of wages since that time. It is a trade in which the articles manufactured are numerous and varied. All work is piece work, the wages list comprising over 5,000 different pieces, while the styles are constantly changing. The vexing question is what shall be the price of a new article, or what the change in price from a change in the old. During these eighteen years, while the difficulty has continued, a result has been reached by argument over the table, while capital and labor have both been employed, and not in the streets while the frames have been idle.

Some four years after the establishment of this Board at Nottingham, and without any knowledge of its existence, a Board was established in the Building Trades of Wolverhampton through the efforts of Mr. Rupert Kettle, a gentleman who devoted ten years to the establishment of arbitration as a principle, and to whom Industrial England owes a debt that has been as yet but imperfectly recognized. This Board differed somewhat from the Nottingham Board. The President was the umpire and was neither an employer nor an employé as in Mr. Mundella's scheme. Mr. Kettle's scheme also provided that the decision of the Board should take the form of working rules, which should be the terms of hiring, any violation of which could be punished the same as the violation of any other contract.

The Boards of Arbitration as formed in England embody the best features of both of these systems. While they differ in detail, their main features are the same. They are all voluntary. They are composed of an equal number of employers and employed, each class electing its own representatives. There is in all of the Boards a provision for conciliation without convening the entire membership. Regular meetings of the Board are provided for, whether there is any business to be transacted or not. And in some form or other there is a power to which either party can appeal without pride or shame, that has power to determine as well as to hear, and whose decisions are received without exultation or humiliation. That is an umpire.

To show what arbitration and conciliation have accomplished, let me give a brief account of its workings in the iron and coal trades.

No severer test of the value of arbitration and conciliation can be found than in the circumstances accompanying its workings in the North of England manufactured iron trade. This trade, including that of the Cleveland district, begun to assume importance as recently as in 1860. For ten years its growth was marvellous, and at the end of this time it rivalled many and surpassed most of the old centers of English iron manufacture. This wonderful growth, at a time when other districts were increasing, created a demand for labor that could not be met from the ranks of those already skilled in the various processes of iron manufacture, and workmen were drawn from all classes and grades of laborers. The result was a most heterogenous collection of workmen. There were no ties of friendship or locality. There were none of those attachments that long companionship causes men to form among themselves and for their employers, and even for the very tools with which they work. Endless disputes followed. Suspicion was the prevailing sentiment of the workmen for the employers, and these had but little sympathy for their employés. Strikes must result from such a state of things. In 1866 the works were stopped six months, and in the end nothing was settled except that capital could hold out longer than labor. From this time until the winter of 1878-9 there were repeated reductions in wages, and the outlook was that when the time came the men would not be slow to take advantage. Happily, however, trouble was avoided, and in May 1869, a Board was formed, and from that time there has not been a general strike in this district. Under this action of the Board, puddling advanced to 13 shillings 3 pence, and by an award, given only last week, it has been reduced to 7 shillings. The Board of Arbitration in this trade at its commencement represented but 18 works. At the end of 1875 it represented the proprietors of 35 works, more than 13,000 subscribing workmen, and fully 30,000 whose wages were regulated by its decisions, and 1,913 puddling furnaces, not quite half as many as the whole United States. The testimonies to the value of this Board, both from employers and employed, are so marked that I ask you to allow me to quote them. I hold in my hand an address, delivered before the British Iron Trade Association in 1876, by Mr. B. Samuelson, M. P., in which he says: "It is interesting to find that the employers in a recent document in the submission of their case for a reduction of wages most readily record their opinion that with a few local exceptions, which do not affect the general principle, the operatives as a body have been loyal to the rules of the Board, one of these rules being that in the event of a dispute the operator shall not abandon his work, but continue his employment pending its adjustment."

I have received a letter from Mr. Ed. Trow, the Secretary of the National Amalgamated Association of Iron Workers, an organization that answers to our Amalgamated Association, of which Mr. Bishop is President. The English association, however, is much larger than the American. Let me quote you what Mr. Trow says: "With regard to my own views on arbitration, I believe it is the only fair and honorable mode that can be adopted for the settlement of questions between capital and labor; that when both parties meet with an earnest desire for a fair and honorable arrangement and discuss the various questions in dispute in a kind and conciliatory spirit there is no fear of failure, but on the contrary, the old feeling of mistrust and jealousy is banished, and confidence in each other is established. The faults in connection with arbitration arise when the workmen come to meetings jealous and suspicious, believing that employers are their natural enemies, and employers, by not conversing with delegates in a free and friendly spirit foster this suspicion, and only through this action is there any fear of failure. Arbitration in England is regarded with great favor by workingmen, and only in a few solitary exceptions has it been refused or its awards rejected by workingmen.

"If you wish arbitration to be successful, employers must meet delegates in a kind and conciliatory spirit, so as to gain the confidence of the workmen, by proving they only desire full and free discussion, and that no advantage will be taken of men for speaking their opinion. Let this be done and arbitration will prove successful, and be a blessing to employers and workmen."

There is another man whose words I wish to quote. One of the ablest leaders the Trades Unionists of England ever had, was John Kane, for a long time and up to his death President of the Amalgamated Malleable Iron Workers of Great Britain. It was largely through his persistent efforts that the Board of Arbitration in this trade was formed. Speaking of arbitration at the Trades Union Congress at Birmingham in 1869, he said: "What is arbitration when properly applied? It is the force of facts, and the application of reason to these facts, as opposed to strikes and barbarous lock-outs. It has been and will be the agent in removing prejudice, preventing the ruinous waste of capital, promoting peace and industry, saving to the workmen their hard-worked earnings, preventing their homes being desolated and their children starved. It promotes contentment, it increases your store. It is the application of the Christian principle—'Come let us reason together.' It is the council chamber where the expense of wear and tear of machinery, the interest on capital, and the market value of labor is considered and awarded. It does not destroy the property of the workman—it preserves and protects it; it prevents strife and promotes mutual understanding between employer and employed. It is the only plan which has been introduced which is calculated to enable the working man and the employing class to consider and understand the interest of each other."

In the coal trade, arbitration has not been as uniformly successful as in the iron. In the Northumberland trade all disputes were settled by arbitration from March, 1873, to 1877, when trouble arose, since which time arbitration has been abandoned. In the Durham coal district, a much larger one, giving employment to some 50,000 miners, from March, 1872, to March, 1877, all questions were referred to arbitration; at the latter date a sliding scale with arbitration was adopted and is still in force. In South Wales, after a strike in 1875 lasting seventeen weeks, and involving a loss variously estimated at from three to five million pounds sterling, a conciliation board was established with a sliding scale. After two years' trial a vote was taken to see if it should be abandoned, which resulted in 8,934 for abandonment and 18,475 against. There was a minimum rate fixed, below which wages were not to go. Three times the miners have consented to a reduction below this rate.

Had I time I could give you the history of its success in other trades, such as the lace, textile, boot and shoe, nut and bolt, nail, iron molding, ironstone mining, quarrying and chemical trades, but this is not necessary. You have neither the time nor the patience to listen to me. Nor has it been my purpose to dwell at length on the advantages or disadvantages of this system. For these I must refer you to my report made to Gov. Hartranft. I have only endeavored to give you a portion of the facts that came to my knowledge, while I tell you frankly that a large part and a better part of its history can not be told. The records of conciliation can not be kept.

And, now, gentlemen, let me in conclusion bespeak from you for this subject your careful consideration, and, if possible, your favorable action. Do I overstate the case when I say that the future relations of capital and labor in this great and busy workshop rests with those here present? And can amicable relations be better promoted than by the adoption of this principle as the method of arranging any differences that may arise? Let me recall to you the eloquent words with which that honored citizen of Pennsylvania, who has just left the gubernatorial chair, closed his last message, when speaking of the future of this State: "To-day it pours over a continent its treasures of coal and iron, of oil and lumber. I believe its true progress lies in extending its industries and educating its laborers. As said last year, the great warfare of the nineteenth century is industrial warfare. In this contest Pennsylvania will enter with unrivaled resources, and wise and liberal legislation ought to give an army of skilled workmen that will win a noble victory."

Strong in the belief that this victory can only be won by the united efforts of capital and labor, working with a common energy towards the same purpose, with reason and not passion as a guide, I present arbitration as a means of bringing about a more harmonious feeling, and of providing a way in which employer and employed may meet to consult and to decide what part each shall have in winning the victory.

I do not claim for arbitration that it is a wonder worker. It is not perfect. It is used by men that are very human, and who, under the present condition of things, are extremely selfish. For these reasons, it will fail to accomplish at times all that is expected. Though it may thus fail, when it is fairly and honestly tried, it will, in most cases, succeed; and, under its action, wherever established, an intelligent co-operation between employers and employed will be effected, and steady employment secured at those rates of wages which the industrial conditions of a competitive market enables capital to pay.

As I stated in the beginning of this address, differences between capital and labor will constantly arise in your midst. They are here now. In all three of your great staple industries—iron, coal, and glass—there are strikes in progress. It is for you to say how these differences shall be settled—whether by reason or by brute force. Decide you must, and in some cases soon. My only object in all my investigations, and in all that I have said or written on this subject, is to aid, if I can, in an honorable, reasonable solution of some phases of that most important of all human problems, the labor question. We are greatly in the dark on this subject. I believe we are moving towards the light. When I look back a hundred years, and see the gradual brightening of what was then the darkest of all social problems, I have no fears of the result. It may be delayed, but reason will rule and determine the nature of the relations of capital and labor. There are certain facts that we may refuse to acknowledge, and, refusing to own, may go on in the old way, but the new way, of reason and a respect for the rights of each other, will win. I believe that arbitration and conciliation will aid in bringing about the recognition of these rights. It is not an end nor a solution of the problem. It is on the way to the end, and is much nearer it than a strike or a lock-out. It will be a day of the greatest promise when in our city we shall put aside the preconceived prejudices and notions of the past. When we shall realize that something higher than brute force has come into the affairs of men to adjust and harmonize them, and when, acting on this belief, we shall urge forward an industrial reorganization on the basis of reason and right. There can be no nobler or more sacred work for men to do.

RULES OF THE BOARD OF ARBITRATION AND CONCILIATION OF THE NORTH OF ENGLAND MANUFACTURED IRON TRADE.

1. That a "Board of Arbitration and Conciliation for the Manufactured Iron Trade of the North of England" be now formed.

2. That the object of the said board shall be to arbitrate on wages or any other matters affecting their respective interests that may be referred to it from time to time by the employers or operatives, and by conciliatory means to interpose its influence to prevent disputes and put an end to any that may arise.

3. The board to consist of one employer and one operative from each works joining the board. Any works more than five miles apart, though belonging to the same firm, may claim to be treated as separate works.

4. The employers to hold a meeting in the month of December in each year, and to select a representative from each works, whose name must be given into the secretaries on or before the first of January next ensuing.

5. The operatives of each works to select a representative by ballot, in the month of December in each year, the name of such representative, and of the works he represents, to be given in to the secretaries on or before the first of January next ensuing.

6. The representatives so chosen to continue in office for the calendar year, immediately following the election, and to be eligible for re-election.

7. If any representative die, or resign, or cease to be qualified by terminating his connection, as employer or operative, with the works he represents, a successor shall be chosen within one month, in the same manner as is provided in the case of annual elections.

8. That each representative be deemed fully authorized to act for the works which has elected him, and that the decision of a majority of the Board, or its referee, binding upon the employers and operatives of all works which have joined t

9. That at the first meeting of the Board, to be held on the second Mon

ary in each year, it shall elect a President and Vice-President, one from the employers and the other from the operatives, and two Secretaries, who shall continue in office till the corresponding meeting of the following year, but shall be eligible for re-election. The President and Vice-President shall be *ex officio* members of all committees.

10. That at the same meeting of the Board a Standing Committee be appointed, to consist of four employers and four operatives in addition to the President and Vice-President, reference being had in the selection to the desirability of representing the various departments of the Trade.

11. All questions shall, in the first instance, be referred to the Standing Committee, who shall investigate and endeavor to settle the matters so referred to it, but it shall have no power to make an award. In the event of the Committee being unable to settle any question, it shall, as early as possible, be referred to the Board.

12. That the President shall preside over all meetings of the Board, and in his absence the Vice-President. In the absence of both President and Vice-President, a Chairman shall be elected by the meeting.

13. That all votes shall be taken at the Board by ballot. That no Chairman of the Board shall be entitled to any second or casting vote. That if at any meeting of the Board the employer representative or the operative representative of any works be absent, the other representative of such works shall not, under the circumstances, be entitled to vote.

14. In case of an equality of votes at the Board, it shall appoint an independent referee, whose decision shall be final and binding.

15. That the Board shall meet for the transaction of business once a quarter, viz., the second Monday in January, April, July, and October, at Darlington, Stockton, Middlesbro', and Newcastle, alternately, but on a requisition to the President, signed by five members of the Board, specifying the nature of the business to be transacted, and stating that it has been submitted to the Standing Committee and left undecided by them, he shall, within fourteen days, convene a meeting of the Board. The circular calling such meeting shall specify the nature of the business for consideration.

16. That all questions requiring investigation shall be submitted to the Standing Committee or to the Board, as the case may be, in writing, to be supplemented by such verbal evidence or explanation as they may think needful.

17. No subject shall be brought forward at any meeting of the Standing Committee or of the Board unless notice thereof be given to the secretaries seven clear days before the meeting at which it is introduced.

18. That the Standing Committee shall meet for the transaction of business on the second Monday in March, June, September, and December, and in addition as often as business requires; the place of meeting to be arranged between the President and secretaries in default of any special direction.

19. That any expenses incurred by the Board be borne equally by the employers and operatives, and that it be the duty of the Standing Committee to establish the most convenient arrangements for collecting what may be needed to meet such expenses.

20. That the sum of eight shillings be paid to each member of the Standing Committee for each attendance at a meeting of that committee.

21. That if any works desires to join the Board at any other time than is contemplated in Rules 4 and 5, such desire shall be notified to the secretaries, and by them to the Standing Committee, who shall thereupon admit such works to membership on being satisfied that representatives have been chosen in the manner prescribed by the Rules.

22. That no alteration or addition be made to these rules, except at the first meeting of the Board, to be held on the second Monday in January in each year, and unless notice in writing of the proposed alteration be given to the secretaries at least one calendar month before such meeting. The notice convening the annual meeting to state fully the nature of any alteration that may be proposed.

NOTE.—The above are the rules as adopted in 1869. There have been some changes, but only in unimportant details.

MINING LAW.

AN ACT

TO REGULATE MINES AND MINING, AND TO REPEAL AN ACT THEREIN NAMED.

SECTION 1. *Be it enacted by the General Assembly of the State of Ohio*, That there shall be appointed by the governor, with the advice and consent of the senate, one mine inspector, who shall hold his office for four years, subject, however, to be removed by the governor for neglect of duty or malfeasance in office. Said inspector shall have knowledge of chemistry, geology, and mineralogy, and a practical knowledge of the different systems of working and ventilating coal mines, and of the nature and properties of the noxious and poisonous gases of mines, particularly fire-damp, and mining engineering; and said inspector, before entering upon the discharge of his duties, shall take an oath or affirmation to discharge the same faithfully and impartially, which oath or affirmation shall be indorsed upon his commission, and his commission, so indorsed, shall be forthwith recorded in the office of the secretary of state, and such inspector shall give bond in the sum of five thousand dollars, with sureties to the approval of the governor, conditioned for the faithful discharge of his duty.

SEC. 2. Said inspector shall give his whole time and attention to the duties of his office, and shall examine all the mines in this state as often as his other duties will permit, to see that the provisions of this act are obeyed; and it shall be lawful for such inspector to enter, inspect, and examine any mine in this state, and the works and machinery belonging thereto, at all reasonable times, by night or by day, but so as not to unnecessarily obstruct or impede the working of the mine; and to make inquiry into the state and condition of the mine as to ventilation and general security, as required by the provisions of this act; and the owners and agent of such mine are hereby required to furnish the means necessary for such entry and inspection, of which inspection the inspector shall make a record, noting the time and all the material circumstances; and it shall be the duty of the person having charge of any mine, whenever loss of life shall occur by accident connected with the working of such mine, or by explosion, to give notice forthwith by mail, or otherwise, to the inspector of mines and to the coroner of the county in which such mine is situated, and the coroner shall hold an inquest upon the body of the person or persons whose death has been caused, and inquire carefully into the cause thereof, and shall return a copy of the verdict and all the testimony to such inspector. No person having a personal interest in, or employed in the management of, the mine where a fatal accident occurs shall be qualified to serve on the jury impaneled on the inquest.

SEC. 3. Said inspector, while in office, shall not act as an agent, or as a manager, or mining engineer, or be interested in operating any mine; and he shall, annually, on or before the first day of January, make report to the governor of his proceedings, and the condition and operation of the mines in this state, enumerating all accidents in or about the same, and giving all such other information as he may think useful and proper, and making such suggestions as he may deem important as to further legislation on the subject of mining.

SEC. 4. Said inspector shall receive a salary of two thousand dollars per annum, and his necessary traveling expenses, to be paid in quarterly installments; and he shall have and keep an office in the state house, at Columbus, in which shall be carefully kept the maps and plans of all mines in this state, and also all records and correspondence, papers, and apparatus, and property, pertaining to his duties, belonging to the state, and which shall be handed over to his successor in office.

SEC. 5. Any vacancy occurring when the senate is not in session, either by death or resignation, removal by the governor, or otherwise, shall be filled by appointment by the governor, which appointment shall be good until the close of the next session of the senate, unless the vacancy is sooner filled as in the first section provided.

SEC. 6. There shall be provided for said inspector all instruments and chemical tests necessary for the discharge of his duties under this act, which shall be paid for on the certificate of the inspector, and which shall belong to the state.

SEC. 7. The owner or agent of every coal mine shall make, or cause to be made, an accurate map, or plan of the working of such mine, on a scale of not less than one hundred feet to the inch, showing the area mined or excavated, and the location and connection with such excavation of the mine of the lines of all adjoining lands, and the name or names of each owner or owners, so far as known, marked on
true copy of which map the said owner or agent shall
inspector within six months after the passage of

copy of which shall be kept at the office of such mine; and the owner or agent shall, on or before the first day of September, 1874, and every four months thereafter, file with said inspector a statement and plan of the progress of the workings of such mine up to said date, which statement and plan shall be so prepared as to enable the inspector to mark the same on the original map or plan herein required to be made. In case of refusal on the part of said owner or agent, for two months after the time designated, to make and file the map or plan, or the addition thereto, the inspector is authorized to cause an accurate map or plan of the whole of said mine to be made at the expense of the owner thereof, the cost of which shall be recoverable against the owner in the name of the person or persons making said map or plan, which shall be made in duplicate, one copy being delivered to the inspector, and the other left in the office of the mine; and he shall, on being paid the proper cost thereof, on demand of any person interested in the working of such mine, or owner of adjoining lands, furnish an accurate copy of any map or plan of the workings of such mines.

SEC. 8. Twelve months from and after the passage of this act it shall not be lawful for the owner or agent of any coal mine worked by a shaft, wherein over fifteen thousand square yards have been excavated, to employ any person to work therein, or to permit any person to work in such mine, unless there are to every seam of coal worked in each mine at least two separate outlets, separated by natural strata of not less than one hundred feet in breadth, by which shafts or outlets distinct means of ingress and egress are always available to the persons employed in the mine; but it shall not be necessary for the two outlets to belong to the same mine; and every shaft opened after the passage of this act shall have two separate outlets, after fifteen thousand square yards have been excavated; and to all other coal mines, whether slopes or drifts, two such openings or outlets shall be provided within twelve months after the passage of this act, provided fifteen thousand square yards have been excavated at or before the passage of this act, or if not, then within twelve months after that extent has been excavated. In case such outlets are not provided as herein stipulated, it shall not be lawful for the agent or owner of any such mine to permit more than ten persons to work therein at any one time. In case any coal mine has but one shaft, slope, or drift for the ingress or egress of the men working therein, and the owner thereof does not own suitable surface ground for another opening, the owner may select and appropriate any adjoining land for that purpose, and for approach thereto, and said owner shall be governed in his proceeding in appropriating such land by the provisions of law in force providing for the appropriation of private property by corporations, and such appropriation may be made whether the owner of such mine is a corporator or not: provided that no land shall be appropriated under the provisions of this act until the court is satisfied that suitable premises cannot be obtained by contract upon reasonable terms.

SEC. 9. The owner or agent of every coal mine, whether shaft, slope, or drift, shall provide and maintain, within six months after the passage of this act, for every such mine, an amount of ventilation of not less than one hundred cubic feet per minute per person employed in such mine, and as much more as the inspector may direct, which shall be circulated to the face of each and every working place throughout the mine; and all mines generating fire-damp shall be kept free of standing gas, and in all mines where fire-damp is generated every working place shall be carefully examined every morning with a safety-lamp, by a competent person, before any of the workmen are allowed to enter.

SEC. 10. The owner or agent of every coal mine operated by shaft or slope, in all cases where the human voice can not be distinctly heard, shall forthwith provide and maintain a metal tube from the top to the bottom of such shaft or slope, suitably calculated for the free passage of sound therein, so that conversations may be held between persons at the bottom and top of the shaft or slope; and there shall also be provided an approved safety-catch, and a sufficient cover over head, on all carriages used for lowering and hoisting persons, and in the top of every shaft an approved safety-gate, and also an approved safety spring on the top of every slope, and an adequate brake shall be attached to every drum or machine used for lowering or raising persons in all shafts or slopes.

SEC. 11. No owner or agent of any coal mine operated by a shaft or slope shall place in charge of any engine used for lowering into or hoisting out of such mine persons employed therein any but experienced, competent, and sober engineers; and no engineer in charge of such engine shall allow any person, except such as may be deputed for that purpose by the owner or agent, to interfere with it or any part of the machinery, and no person shall interfere or in any way intimidate the engineer in the discharge of his duties; and in no case shall more than ten men ride on any cage or car at one time, and no person shall ride upon a loaded cage or car in any shaft or slope.

SEC. 12. All the safety-lamps used for examining coal mines, or which may be used in working any mine, shall be the property of the owner of the mine, and shall be under the charge of the agent of such mine; and in all mines generating explosive gas, the doors used in assisting or directing the ventilation of the mine shall be so hung and adjusted they will shut of their own accord, and can not stand open: and in all such mines the mining boss shall keep a careful watch over the ventilating apparatus, and the air-ways, and he shall me sure the ventilation at least once a week at the inlet and outlet, and also at or near the face of all the entries; and all such measurements shall be reported once a month to the inspector.

SEC. 13. No boy under twelve years of age shall be allowed to work in any mine, nor any minor between the ages of twelve and sixteen years, unless he can read and write: and in all cases of minors applying for work, it shall be the duty of the agent of such mine to see that the provisions of this section are not violated.

SEC. 14. In case any coal mine does not, in its appliances for the safety of the persons working therein, conform to the provisions of this act, or the owner or agent disregards the requirements of this act, any court of competent jurisdiction may, on application of the inspector, by civil action in the name of the state, enjoin or restrain the said owner or agent from working or operating such mine with more than ten miners at once, until it is made to conform to the provisions of this act; and such remedy shall be cumulative, and shall not take the place of or affect any other proceedings against such owner or agent authorized by law for the matter complained of in such action.

SEC. 15. Any miner, workman, or other person, who shall knowingly injure or interfere with any safety-lamp, air-course, or brattice, or obstruct or throw open doors, or disturb any part of the machinery, or disobey any order given in carrying out the provisions of this act, or ride upon a loaded car or wagon in a shaft or slope, or do any act whereby the lives or health of the persons, or the security of the mines and machinery, is endangered, or if any miner or person employed in any mine governed by the provisions of this act, shall neglect or refuse to securely prop or support the roof and entries under his control, or neglect or refuse to obey any order given by the superintendent in relation to the security of the mine in the part of the mine under his charge or control, every such person shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine not exceeding fifty dollars, or imprisoned in the county jail not exceeding thirty days, or both, at the discretion of the court.

SEC. 16. Whenever written charges of gross neglect of duty or malfeasance in office against any inspector shall be made and filed with the governor, signed by not less than fifteen coal-miners, or one or more operators of mines, together with a bond in the sum of five hundred dollars, payable to the state, and signed by two or more responsible freeholders, and conditioned for the payment of all costs and expenses arising from the investigation of such charges, it shall be the duty of the governor to convene a board of examiners, to consist of two practical coal-miners, one chemist, one mining-engineer, and one operator, at such time and place as he may deem best, giving ten days' notice to the inspector against whom the charges may be made, and also to the person whose name appears first in the charges; and said board, when so convened, and having been first duly sworn or affirmed truly to try and decide the charges made, shall summon any witnesses desired by either party, and examine them, on oath or affirmation, which may be administered by any member of the board, and depositions may be read on such examination as in other cases; and the board shall examine fully into the truth of such charges, and report the result of their investigation to the governor; and if their report shows that such inspector has grossly neglected his duties, or is incompetent, or has been guilty of malfeasance in office, it shall be the duty of the governor forthwith to remove such inspector and appoint a successor; and said board shall award the costs and expenses of such investigation against the inspector, or the person signing said bond, according to their finding against said inspector or in his favor, which costs and expenses shall include the compensation of such board of five dollars per day for each member for the time occupied in the trial, and in traveling from and to their homes; and the attorney-general shall forthwith proceed to collect such costs and expenses, and pay the same into the state treasury, the said costs and expenses being in the first instance paid out of the state treasury on the certificate of the president of such board.

Sec. 17. In all coal mines in this state, the miners employed and working therein, the owners of the land, or other persons interested in the rental or royalty of any such mine, shall, at all proper times, have full right of access, and examination of all scales, machinery, or apparatus used in or about said mine to determine the quantity of coal mined, for the purpose of testing the accuracy and correction of all such scales, machinery, or apparatus; and such miners, land-owners, or other persons, may designate or appoint a competent person to act for them, who shall, at all proper times, have full right of access and examination of such scales, machinery, or apparatus, and seeing all weights and measures of coal mined, and the accounts kept of the same: provided, not more than one person on behalf of the miners collectively, or one person on behalf of the land-owners, or other persons, interested in the rental or royalty jointly, shall have such right of access, examination, and inspection scales, weights, measures, and accounts at the same time, and that persons shall make no unnecessary interference with the use of such scales, machinery, or apparatus.

SEC. 18. The provisions of this act shall not apply to or affect any coal mine in which not more than ten men are employed at the same time: provided, that on the application of the proprietor of, or miners in any such mine, the inspector shall make, or cause to be made, an inspection of such mine, and direct and enforce any regulations in accordance with the provisions of this act that he may deem necessary for the safety or the health and lives of the miners.

SEC. 19. The act entitled "an act to regulate coal mines and the working thereof," passed April 29, 1872, is hereby repealed.

SEC. 20. This act shall take effect and be in force from and after its passage.

THE COAL TRADE.

CLEVELAND, OHIO.

This city receives a fine and varied assortment of bituminous coal. A great many coal basins—in fact, nearly all the Ohio formation, as well as most of the coals lying west of the Alleghany Mountains, in Pennsylvania—here find a market and a distributing point for the west, northwest, eastern, and Canada trade. The great number of vessels employed in the iron ore and lumber trade, naturally seek coal as a back freight for ballast, which enables Cleveland to place coal in distant ports, like Chicago, Milwaukee, and on Lake Superior, at merely nominal rates. The business has been developed within the last fifteen years, and taking the rapid growth of the manufacturing interest in the West into consideration, it is safe to presume that the trade has not yet reached its ultimate proportions.

The total receipts of coal at Cleveland, from 1828 to 1852, amounted to 662,862 tons, having increased from thirty tons in 1828, to 137,926 tons in 1852, the coal being mined in the districts named below:

Years.	District.	Tons for the year.
1828..	Tallmadge	30
1829..	Tallmadge	708
1830..	Tallmadge	1,178
1840..	Tallmadge, New Castle, Trenton	6,028
1850..	Tallmadge, Clinton, New Castle, Youngstown, Cuyahoga Falls, Girard, and Rochester	83,850
1851..	Tallmadge, Clinton, New Castle, Youngstown, Cuyahoga Falls, Girard, and Rochester	107,135
1852..	Tallmadge, Clinton, New Castle, Youngstown, Cuyahoga Falls, Girard, and Rochester	137,926

The canal from Akron was opened July 4, 1828, and during that year the thirty tons of coal sent to Cleveland was received by this route. The coal was taken from the mines to the canal with teams to be shipped, and the business was continued in this way until 1832, when the canal reached the coal fields near Massillon, which were on its banks. The receipts by this route represent the consumption of coal at Cleveland up to 1838. It was not until after this, when the Briar Hill coal began to be received, in 1843, that lake steamers used coal from this place. Since 1845, its use has supplanted that of wood on the steamers of the lower lakes. Until 1845 the entire trade of the lakes in bituminous coal, was in the hand of Cleveland dealers. About this time, possibly a year or two ear Erie began to ship coal, the joint receipts from the interior, at th places, being only 45,136 tons. The following will serve to show the growth of the trade:

Years.	Tons.	Years.	Tons.
1865	465,550	1872	1,348,160
1866	583,407	1873	1,599,212
1867	668,026	1874	1,215,353
1868	759,104	1875	1,414.124
1869	922,757	1876	1,250,531
1870	904,600	1877	1,363,345
1871	1,165,940		

The ton designated is that of 2,000 pounds. The shipments from this point by lake have been—

	1875.	1876.	1877.
To ports in British Provinces	140,637	156,857	80,243
To domestic ports	529,211	362,834	276,666

COAL TRADE OF THE UNION.

The following table gives the tonnage for the year 1869, as per census reports made in 1870, together with figures for the year 1877 where available; in other cases a careful estimate, based upon reports of the trade in the various States, has been made—3,000,000 tons have been added to the anthracite of Pennsylvania for local consumption and unreported business:

States.	1869—tons.	1877—tons.
Pennsylvania anthracite	15,610,275	23,619.911
" bituminous	7,798,517	12,500,000
Illinois	2,629,563	3,500,000
Ohio	2,527,285	5,250,000
Maryland	1,819,824	1,574,339
Missouri	621,930	900,000
West Virginia	608,878	1,000,000
Indiana	437,870	1,000,000
Iowa	263,487	1,500,000
Kentucky	150,582	850,000
Tennessee	133,418	750,000
Virginia	61,803	90.000
Kansas	32,938	200,000
Oregon	....	200,000
Michigan	21,150	30,000
California	....	600,000
Rhode Island	14,000	14,000
Alabama	11,000	175,000
Nebraska	1,425	50,000
Wyoming	50,000	100,000
Washington	17,844	150,000
Utah	5,800	45,000
Colorado	4,500	300,000
Total	32,860,690	54,398,250

COAL PRODUCTION OF THE GLOBE—1870 TO 1876.

Country.	Square miles.	1870.	1871.	1872.	1873.	1874.	1875.	1876.
Great Britain	11,900	110,431,192	117,352,028	123,497,316	127,016,747	125,067,916	131,867,105	133,344,766
United States	192,000	32,863,690	41,000,000	45,000,000	50,512,000	47,872,963	49,694,652	49,005,748
Germany	1,770	23,316,238	37,852,463	42,324,466	40,335,741	40,655,332	42,283,097	43,364,968
France	2,086	6,550,000	13,400,000	15,899,005	17,500,000	17,059,547	16,949,031	17,047,760
Belgium	510	13,697,118	13,733,176	15,158,948	15,778,401	14,669,029	14,743,271	15,500,000
Austria	1,800	6,443,575	9,891,350	10,389,952	10,500,000	11,000,000	10,895,000	11,500,000
Russia	30,000	817,008	829,722	1,097,832	1,123,940	1,343,558	1,750,000	1,750,000
Spain	3,501	414,482	500,000	570,000	589,707	600,000	560,000	500,000
Portugal	....	....	....	18,000	18,000	18,000	18,000	18,000
Nova Scotia	18,000	625,769	673,242	880,950	1,051,567	872,720	781,165	709,646
Australia	24,840	868,564	915,784	1,040,154	1,226,475	1,304,567	1,450,000	1,600,000
India	2,004	500,000	500,000	600,000	850,000	850,000	850,000	1,000,000
Japan	5,000	....	....	84,000	150,000	390,000	325,500	350,000
Vancouver's Island	390	29,863	45,000	75,000	75,000	81,397	110,145	140,087
Other countries *	....	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Totals	....	197,557,499	247,692,764	258,141,623	267,737,179	262,785,029	272,266,966	276,830,965

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* Italy, New Zealand, Chili, China, etc.

LABOR LEGISLATION.

The labor legislation of Ohio is comprised in a few but very important acts:

1. The act making ten hours a legal days' work.
2. The act providing for the creation of coöperative trading associations.
3. The act creating the Bureau of Labor Statistics.
4. The act against charging more than regular retail rates for merchandise furnished employes.
5. The act maing it illegal to pay the wages of labor in checks or scrip redeemable in merchandise.
6. The act to prevent oppression of citizens of Ohio by carrying suits out of the State to evade the exemption laws of the State.
7. To secure the wages of labor in case of the assignment of an employer.
8. To exempt three months' personal earnings from attachment for debt, where defendant is the head of a family.
9. Permitting no stay of execution, when a judgment is secured for wages due for labor performed.
10. The lien law.

Six of these laws were enacted during the year 1878. The following bills are yet pending:

1. A bill to make eight hours a legal day's work.
2. A bill authorizing the creation of coöperative associations for manufacturing or mining purposes.
3. A bill to establish courts of arbitration or conciliation.
4. A bill to compel railroad corporations to pay the wages of employes out of moneys received, before any other debts of such corporations are paid.

THE LABOR LAWS OF OHIO.

An Act to punish certain offenses therein named.

[Passed April 27, 1878.]

SECTION 1. *Be it enacted by the General Assembly of the State of Ohio*, That it shall be unlawful for any person, firm, or corporation to pay the wages of labor in goods or supplies, through the intervention of scrip, or any other evidence of indebtedness, or otherwise, at higher prices than current cash rates for like goods and supplies at the nearest retail market: provided, that the actual cost of the transportation of such goods and supplies, from such nearest market to the place of sale, may be added.

SEC. 2. It shall be unlawful for any person, firm, or corporation to sell goods, or supplies to laborers on orders or other evidences of indebtedness issued to such laborers by their employers, or to sell to laborers by any arrangement with their employers, by which such laborers are to receive such goods or supplies on their wages at higher prices than current cash rates for like goods and supplies, at the nearest retail market: provided, that the actual cost of the transportation of such goods and supplies, from such nearest market to the place of sale, may be added.

SEC. 3. Any person making any sale in violation of this act, whether as principal, agent, clerk, or otherwise, shall be deemed guilty of a misdemeanor, and, upon conviction thereof, shall be fined not less than five dollars nor more than fifty dollars.

SEC. 4. This act shall take effect and be in force from and after its passage.

An Act supplementary to an act "to amend, revise, and consolidate the statutes relating to crimes and offenses, and to repeal certain acts therein named, to be known as title one, crimes and offenses, part four of the act to revise and consolidate the general statutes of Ohio," passed May 5, 1877 (vol. 74, p. 240).

[Passed May 10, 1878.]

SECTION 1. *Be it enacted by the General Assembly of the State of Ohio,* That it shall be unlawful for any person, firm, company, or corporation to issue or use any scrip, token, check, draft, or certificate of indebtedness, payable otherwise than in money in the payment of or accounting to any person for the wages of work and labor.

SEC. 2. It shall be unlawful for any person, firm, company, or corporation to issue, use, or circulate, or cause to be issued, used or circulated any check, token, promise in writing, or evidence of indebtedness, designed, intended, or calculated to be circulated or issued as money or in lieu of money, other than lawful money of the United States.

SEC. 3. Any person or persons offending against any of the provisions of this act, shall be held guilty of a misdemeanor, and upon conviction thereof before any court of competent jurisdiction, shall be fined in any sum not less than ten dollars nor more than one hundred dollars.

SEC. 4. This act shall take effect from and after its passage.

An Act to prevent the practice of resorting to distant courts to oppress the citizens of Ohio, and deprive them of their rights under the statutes of Ohio.

[Passed May 11, 1878.]

SECTION 1. *Be it enacted by the General Assembly of the State of Ohio,* That if any person or persons, as principal, agent, or attorney, with intent thereby to deprive any bona fide resident of the State of Ohio of his or her rights under the statutes of Ohio to exempt personal earnings from application to the payments of debts in certain cases, shall send or cause to be sent out of the State of Ohio, any claim for debt to be collected by proceedings in attachment, when the creditor, debtor, and person or corporation owing for the earnings intended to be reached by such proceedings in attachment, are each and all within the jurisdiction of the courts of the State of Ohio, such person, whether principal, agent, or attorney, shall be deemed and held to be guilty of a misdemeanor, and upon conviction thereof, shall be fined for each and every claim so sent, in any sum not less than twenty dollars, or more than fifty dollars, at the discretion of the court.

SEC. 2. That any person who shall, either directly or indirectly, assign or transfer any claim for debt against a citizen of Ohio, for the purpose of having the same collected by proceedings in attachment in courts outside of the State of Ohio, when the creditor, debtor, and person or corporation owing the money intended to be reached by proceedings in attachment, are each and all within the jurisdiction of the courts of the State of

Ohio, such person shall be deemed and held to be guilty of a misdemeanor, and upon conviction thereof, shall be fined in any sum not less than twenty dollars nor more than fifty dollars for each offense.

SEC. 3. This act shall take effect and be in force from and after its passage.

An Act to amend an act entitled "an act supplementary to the act regulating the mode of administering assignments in trust for the benefit of creditors," passed April 6, 1867, passed March 6, 1861. (Vol. 58, page 26.)

[Passed May 7, 1878.]

SECTION 1. *Be it enacted by the General Assembly of the State of Ohio,* That every person who shall have performed any labor in the service of any person or corporation who shall hereafter assign property in trust for the benefit of creditors, shall be entitled to receive out of the trust fund, when the same is insufficient to pay all debts of the assignor, the full amount of the wages due to such person for such labor, not exceeding three hundred dollars: provided, that such labor shall have been performed within twelve months immediately preceding the assignment.

SEC. 2. That section one of the above recited act be and the same is hereby repealed.

SEC. 3. This act shall take effect from and after its passage.

An Act to revise and consolidate the laws relating to procedure before justices of the peace and mayors. Chapter 1, section 17, on attachments.

[Passed May 11, 1878.]

The plaintiff shall have an order of attachment against any property of the defendant, except as hereinafter provided, in a civil action before a justice of the peace, for the recovery of money before or after the commencement thereof, when there is filed in his office an affidavit of the plaintiff, his agent or attorney, showing the nature of the plaintiff's claim, that it is just, the amount the affiant believes the plaintiff ought to recover, *and that the property about to be attached is not exempt from execution, and is not the personal earnings of the defendant for services rendered by the defendant within three months, prior to the commencement of said action, or, if such earnings are sought to be attached, that they amount to more than one hundred and fifty dollars, and that only the excess over that amount is sought to be attached, or that the defendant is not the head or support of a family,* and also the existence of some one or more of the following particulars:

1. That the defendant, or one of several defendants, is a corporation, having no officer upon whom a summons can be served, or place of doing business in the county, or is a non-resident of the county; or,

2. Has absconded with intent to defraud his creditors; or,

3. Has left the county of his residence to avoid the service of a summons; or,

4. So conceals himself that a summons can not be served upon him; or,

5. Is about to remove his property, or a part thereof, out of the county, with intent to defraud his creditors; or,

6. Is about to convert his property, or a part thereof, into money, for the purpose of placing it beyond the reach of his creditors; or,

7. Has property, or rights of action, which he conceals; or,

8. Has assigned, removed, or disposed of, or is about to assign, remove, or dispose of his property, or a part thereof, with intent to defraud his creditors; or,

9. Fraudulently or criminally contracted the debt, or incurred the obligation, for which suit is about to be, or has been brought. When the defendant is a corporation, having no officer in the county upon whom a summons can be served, or place of doing

business in the county, or is a non-resident of the county, the attachment shall not be granted, unless the claim is for a debt or demand arising upon contract, judgment, or decree, *and no attachment shall issue by virtue of this chapter against the personal earnings of any defendant for services rendered by such defendant, within three months before the commencement of the action or the issuing of the attachment, unless the defendant is not the head or support of a family, or unless the amount of such earnings exceeds one hundred and fifty dollars, and then only as to the excess over that amount.*

(The italics represent the changes made in the law at the session of 1878.)

An Act to revise and consolidate the laws relating to procedure before justices of the peace and mayors. Chapter 12, section 5.

[Passed May 11, 1878.]

No stay of execution on judgment rendered in the following cases shall be allowed:

1. On judgments rendered against justices of the peace for refusing to pay over money by them collected or received in their official capacity.

2. On judgments against justices of the peace for not reporting, annually, to the auditor all fines as required by law.

3. On any judgment rendered against a constable for failing to make return, or making a false return, or refusing to pay over money collected in his official capacity.

4. On judgments against bail for the stay of execution.

5. Where judgment is rendered in favor of bail who have been compelled by judgment to pay money on account of their principal.

6. On judgments obtained by constables on undertakings executed to them for the delivery of property, or undertakings executed to an officer in replevin of property levied on by execution.

7. On judgment rendered in favor of any person for wages due for manual labor by him performed.

The last paragraph (7) is the amendment to the old law.

The following law is the only one under which trade unions may legally organize:

An Act supplementary to an act entitled "An act to provide for the creation and regulation of incorporated companies in the State of Ohio," passed May 1, 1852.

[Passed April 20, 1872.]

SECTION 1. *Be it enacted by the General Assembly of the State of Ohio,* That any number of persons not less than five, may associate themselves together, as provided in the first section of the act entitled "An act to provide for the creation and regulation of incorporated companies in the State of Ohio," passed May 1, 1852, for the purpose of mutual protection and relief of its members, and for the payment of stipulated sums of money to the families or heirs of the deceased members of such association.

SEC. 2. That the trustees and officers thereof shall be chosen in such manner and for such time as may be provided in the rules and regulations of such association, and when chosen, said trustees shall, under their hands and seals, make a certificate which shall specify as follows:

First—The name of such association, and by which it shall be known.

Second—The name of the place where its principal office is or shall be located.

Third—The manner of carrying on the business of said association.

WAGES AND EARNINGS IN OHIO—Continued.

Occupations.	Average.		
	Weeks employed.	Weekly wages.	Weekly earnings. (52 weeks)
Paper Boxes, etc.—Continued.			
Unskilled	51	$7 32	$7 22
Boys	48	3 15	2 80
Females	50	4 44	4 24
Flax and Bagging—			
Skilled	39	10 60	8 09
Unkilled	36	6 75	4 74
Boys and Females	48	4 37	4 08
Carriage Wheels, etc.—			
Skilled	49	11 61	10 96
Unskilled	48	7 75	7 21
Boys	48	3 45	3 19
Wood Bending—			
Skilled	47	9 36	8 47
Unskilled	48	7 36	6 86
Boys	43	3 27	2 71
Potteries—			
Skilled	47½	13 90	12 70
Unskilled	47½	8 31	7 59
Boys	47½	3 00	2 73
Females	47½	4 22	3 85
Stoneware—			
Skilled	43½	11 31	9 43
Unskilled	44	7 00	5 93
Boys	47½	3 80	3 48
Sewer Pipe—			
Skilled	40	11 83	9 15
Unskilled	41	7 26	5 75
Other Manufactures of Clay—			
Skilled	....	9 00	....
Unskilled	....	7 00	....
Stone Quarries—			
Skilled	36	8 96	6 64
Unskilled	36	7 83	5 24
Flour Mills—			
Employés	51	10 52	10 34
Organs, etc.—			
Skilled	46½	12 14	11 19
Unskilled	52	7 50	7 50
Boys	39	2 26	2 01
Marble Works—			
Skilled	43	12 61	10 51
Unskilled	37	9 34	6 64
Apprentices	52	5 00	5 00
Tanneries—			
Skilled	49	10 55	9 91
Unskilled	52	7 77	7 72
Boys	52	3 50	3 50
Jewelry—			
Skilled	48	13 91	12 92
Unskilled	48	10 80	9 94
Boys	52	3 08	3 08
Females	52	5 35	5 35
Glass—			
Skilled	30½	14 01	8 42
Unskilled	30½	7 95	4 69
Boys	30	3 42	1 95
Females	27½	3 41	1 82

WAGES AND EARNINGS IN OHIO—Continued.

Occupations.	Average.		
	Weeks employed.	Weekly wages.	Weekly earnings. (52 weeks)
Brass—			
Skilled	47	$11 51	$10 49
Unskilled	49	6 36	6 02
Apprentices	52	3 25	3 25
Bridges—			
Skilled	44	12 11	10 41
Unskilled	44	8 53	7 18
Boys	50	4 34	4 21
Boilers—			
Skilled	45	12 34	10 87
Unskilled	48	7 83	7 31
Boys	51	4 46	4 44
Safes—			
Skilled	51	13 12	12 81
Unskilled	51	9 41	9 09
Boys	51	2 76	2 70
Saws—			
Skilled	49	15 21	14 18
Unskilled	49	7 53	7 01
Boys	50	3 80	3 68
Files—			
Skilled	49	11 25	10 75
Boys	50	3 33	3 22
Axles, Bolts, Nuts, etc.—			
Skilled	50	11 86	11 32
Unskilled	50	8 10	7 85
Boys	50	3 62	3 49
Miscellaneous Iron—			
Workmen	49	10 04	9 60
Ship Building—			
Skilled	....	10 50	....
Unskilled	....	6 07	....
Breweries—			
Skilled	52	13 70	13 70
Unskilled	52	12 06	12 06
Furniture—			
Skilled	50½	10 85	10 52
Unskilled	50½	6 00	5 82
Youth	50½	2 71	2 63
Rubber—			
Skilled	48½	10 12	9 44
Boys and girls	48½	3 25	3 03
Brushes and Brooms—			
Men	47½	8 95	8 17
Youth	47½	3 33	3 04
Bakeries, etc.—			
Skilled	52	11 85	11 85
Unskilled	52	8 63	8 63
Boys	52	3 80	3 80
Females	52	3 38	3 38
Silk Hats—			
Skilled	30½	11 20	6 61
Women	30½	6 86	4 58
Boots and Shoes—			
Skilled	45½	13 61	11 75
Unskilled	45½	8 92	7 83
Boys	45½	3 21	2 78
Females	45	5 02	4 33

WAGES AND EARNINGS IN OHIO—Continued.

Occupations.	Average.		
	Weeks employed.	Weekly wages.	Weekly earnings. (52 weeks)
Spice Mills—			
Men	52	$11 29	$11 29
Paint—			
Skilled		14 41	
Unskilled		6 33	
Boys		4 25	
Dye Houses—			
Skilled		11 35	
Unskilled		6 00	
Boys		3 50	
Females		6 00	
Blast Furnaces—			
Keepers		9 66	
Fillers		8 22	
Mechanics		11 20	
Laborers		6 54	
Rolling Mills—			
Heaters		25 10	
Puddlers		18 34	
Rollers		24 09	
Other mechanics		13 34	
Helpers		10 12	
Laborers		7 75	
Nailers		28 65	
Boys		6 29	
Other employés of Blast Furnaces and Rolling Mills—			
Ore miners		6 14	
Coal miners, men		9 66	
" boys		4 55	
Tobacco and Cigars—			
Skilled	52	9 85	9 85
Unskilled	52	7 41	7 41
Boys	52	3 50	3 50
Girls	52	3 75	3 75
Miscellaneous—			
Skilled	46	9 47	8 43
Unskilled	42	7 60	6 12
Boys	44	3 23	2 77
Women	51	4 07	4 00

From the foregoing it will readily be seen that the prosperity of the laborer cannot be gauged from a knowlege of his weekly wages, but that the number of weeks' employment must also be known.

There are a large number of idle men in the State, men able to work and anxious to secure employment; this is made evident by the returns of employers to the Bureau.

WAGES AND EARNINGS OF COAL MINERS.

Number of return.	Earnings per day when fully employed.	Hours of labor per day.	Average day's earnings in 1878 to July 1st.	Total earnings for year ending July 1, 1878.	Deductions for powder, etc.	Net earnings for the year.
1	$1 40	9	$1 00	$286 00	$40 00	$246 00
2	1 12	9	75	230 00	13 75	216 25
3	75	10	45	140 85	18 50	122 35
4	1 75	9	1 25	375 00	31 20	343 80
5	1 80	9	1 50	450 00	95 08	354 92
6	1 15	10	75	239 00	39 00	200 00
7	2 50	10	2 50	578 00	68 10	509 90
8	....	9	1 00	340 81	45 30	295 51
9	1 00	9	75	288 44	34 10	254 34
10	1 75	9	82	329 65	23 80	305 85
11	1 75	9	1 18	394 58	27 00	367 58
12	1 75	9½	1 75	364 41	56 42	307 99
13	....	10	75	103 70	7 00	96 70
14	1 25	10	69	223 50	23 00	200 50
15	2 50	10	1 30	412 86	33 81	379 05
16	2 12	10	....	250 00	30 00	220 00
17	1 45	11	80	268 40	....	268 40
18	1 80	10½	1 25	350 00	35 00	315 00
19	1 75	10	75	345 00	49 00	296 00
20	2 25	10	....	(a) 733 99	65 25	668 74
21	1 50	10	....	360 00	54 00	306 00
22	1 70	11	1 25	370 00	30 90	339 10
23	1 45	9	....	431 02	25 60	405 42
24	1 40	10	....	(b) 204 96	7 00	197 96
25	1 25	10	70	236 00	25 00	211 00
26	....	10	1 59	544 25	30 74	513 51
27	2 66	9	1 38	419 59	15 00	404 59
28	1 25	9	50	250 00	12 00	238 00
29	1 28	8	80	249 60	6 00	243 60
30	1 78	9	1 75	460 80	....	460 80
31	1 50	10	1 00	365 00	59 00	306 00
32	1 62	10	81	300 00	40 00	260 00
33	2 00	9½	1 08	(c) 340 29	63 20	277 09
34	1 10	9	....	(d) 340 74	67 96	272 78
35	1 30	11	84	264 91	23 59	241 32
36	1 75	9	1 00	(f) 450 00	138 00	312 00
37	1 35	10	97	358 72	67 00	291 00
38	1 50	9	1 00	300 00	31 00	269 00
39	1 50	10	60	240 00	46 40	193 60
40	1 30	11	....	(e) 703 38	114 00	589 38
41	1 50	10	73	263 46	....	263 46
42	2 00	....	80	257 00	57 00	200 00
43	1 25	11	....	375 76	28 00	347 66

(a) Father and son, 1½ turns.
(b) Earnings six months.
(c) Earnings ten months.
(d) Father and two sons.
(e) " " "
(f) Average for four months.

SIXTH ANNUAL REPORT

OF THE

STATE INSPECTOR OF MINES,

TO THE

GOVERNOR OF THE STATE OF OHIO,

FOR THE YEAR 1880.

◆

COLUMBUS:
G. J. BRAND & CO., STATE PRINTERS.
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ANNUAL REPORT.

COLUMBUS, OHIO, *November* 15, 1880.

To His Excellency, CHARLES FOSTER, *Governor of Ohio:*

SIR: In compliance with the requirements of the act of the General Assembly entitled an "Act to regulate mines and mining, and to repeal an act therein named," passed March 21, 1874, I submit herewith the sixth annual report of this office. As this is the seventh year of the existence of the office, and the Mine Inspector is required by law to "make an annual report to the Governor of his proceedings and the condition and operation of the mines of the State," it should be the seventh annual report; but as no report was made for the year 1879, it is in reality only the sixth annual report, and so I have named it. This report contains statistics of the coal production for a series of years, a list of the mining casualties for the past twelve months, and a comparison of the number of persons killed to the amount of coal mined; a brief statement of the labors of the Mine Inspector during the year; also, a brief sketch of the coal fields of the State; a description of the mines and the modes of ventilation in use; a sketch of legislation for the protection of miners; recommendations for the perfection of the mining law, and such other matters and things in connection with mines and mining as I have deemed of importance, including a copy of the statute regulating mines and mining in this State, the mining law governing the bituminous coal mines of Pennsylvania, and an abstract of the British law regulating and inspecting the mines of the United Kingdom.

The mining industry of the State is yearly growing in magnitude. For the 12 months ending May 31, 1880, the output of the mines was 6,437,725 tons. The aggregate production of the State for the year ending December 31, 1880, I estimate will reach, if it does not exceed, seven million tons; for during the winter of 1879-80, the Massillon region, one of the most important in the State in point of production, was idle, owing to a strike of the miners, the strike lasting seven months.

During the past summer, also, the Corning district of the Sunday Creek Valley commenced shipping coal, adding materially to the output. Our mines have been free from any unusual accidents during the year, and the death list, which was greater than that of British mines in the year 1874, the first year of official supervision of the coal mines of Ohio by State authority, in proportion to the number of tons raised, has been reduced to perhaps a minimum amount.

Respectfully submitted,

ANDREW ROY,
State Inspector of Mines.

THE COAL PRODUCTION OF THE STATE, AND MINING CASUALTIES.

I have never been able to furnish a thoroughly accurate statement of the annual coal production of the State, for two reasons: First, want of the necessary time to collect statistics; and second, an unwillingness on the part of a number of mining companies to furnish prompt and reliable returns of the output of their mines. During the first three years of my former term of office, I prepared and sent circulars to the different mining companies doing business in this State, requesting them to furnish this office with a statement for publication in the annual reports of the Mine Inspector, of the amount of coal mined in tons of 2000 pounds, assuring all that the returns made would be treated as strictly confidential, and would not be published, except in the aggregate production of the State. Answers were not as generally returned as I could have wished, and finding it required more time to secure satisfactory results than I was able to give to this department, I made no attempt during the year 1878 to collect the output of the mines. I feel well assured, that now little or no opposition would be offered on the part of any mine operator in the State to furnish an annual statement of the product of the mines for publication. But unless some clerical or other assistance is furnished this office, it will be impossible for the Mine Inspector to give any attention to such work.

From the reports made to this office, in answer to inquiries sent to the different mining companies doing business in the State, and from as careful estimates as could be made during official visits to the mines where no returns were sent me, I was able during my first official term to report the annual coal production for the following years, as follows:

1872	5,315,294	tons.
1873	5,450,028	"
1874	3,267,585	"
1875	4,864,259	"
1876	3,500,000	"
1877	5,250,000	"
1878	5,500,000	"
1879	6,000,000	"

The years 1878 and 1879 are estimated, as no attention was paid to such matters by the Mine Inspector during those years.

Through the courtesy of Gen. Francis A. Walker, Superintendent of the Census of the United States, Prof. Raphael Pumpelly, special agent of the census office, and Prof. Edward Orton, special agent for the collection of the Mineral Statistics of Ohio, for the 10th census of the United States, I am able to present a very complete statement of the coal production of the State, including the value of the coal at the mines, etc., for the twelve months ending May 31, 1880.

The following is the summary by counties:

STATISTICS OF THE COAL MINES OF OHIO, FOR THE YEAR ENDING MAY 31, 1880.

Counties.	Tons.	Value.	Number of large mines.	Number of employes.	Number of small mines.	Number of employes.
Athens	589,195	$598,898	12	1219	14	51
Belmont	452,754	456,890	16	716	35	138
Carroll	20,692	27,227	2	43	18	49
Columbiana	541,466	596,264	18	1332	16	52
Coshocton	62,990	74,494	4	159	11	49
Gallia	19,941	20,311	1	23	16	35
Guernsey	168,480	184,400	5	314	10	34
Harrison	45,860	45,860	3	52	14	72
Hocking	176,852	176,000	4	349	3	5
Holmes	17,460	26,190	1	21	10	25
Jackson	196,452	249,385	18	587	21	72
Jefferson	388,199	350,543	13	768	10	66
Lawrence	118,929	149,105	6	300	4	6
Mahoning	347,635	693,826	15	1095	1	10
Medina	106,000	170,000	2	312	....	....
Meigs	388,786	469,203	11	1106	....	....
Monroe	1,600	2,000	....	....	1	8
Morgan	10,520	10,915	....	....	16	34
Muskingum	129,869	133,504	8	181	43	182
Noble	21,520	24,350	1	19	14	31
Perry	1,058.254	1,142,934	19	1988	8	43
Portage	26,500	60,625	2	132	1	4
Scioto	7,443	10,637	....	....	13	21
Stark	344,397	492,951	15	1346	31	143
Summit	130,165	224,413	7	494	4	63
Trumbull	673,206	1,383,370	14	2041	7	11
Tuscarawas	246,229	309,352	15	605	27	105
Vinton	61,908	82,882	2	190	12	30
Washington	28,800	30,200	1	30	9	19
Wayne	55,623	85,250	1	200	14	42
Totals	6,437,725	$8,281,979	216	15,622	383	1350

The reports of the coal production of the State, as published in the statistical department of the office of Secretary of State, from the reports made to the county auditors by township assessors, are very unsatisfactory, as the following comparison will show:

Mine Inspector.		Secretary of State.	
Years.	Tons.	Years.	Tons.
1872	5,315,294	1872	4,417,550
1873	5,450,028	1873	3,511,769
1874	3,267,585	1874	No report.
1875	4,864,259	1875	3,915,072
1876	3,500,000	1876	3,636,318
1877	5,250,000	1877	3,501,955
1878	5,550,000	1878	3,526,804
1879	6,000,000	1879	5,874,486

Both of these reports cannot be accurate, and the fact is, that neither are so. Where the reports of the Mine Inspector are at fault, it is in the estimate being too low, rather than too high. It will be observed that the report by the Secretary of State approximates the estimate of the Mine Inspector for the year 1879, but this is the result of a blunder. The production of Tuscarawas county, for the year 1879, is stated in the Secretary's report at 35,059,607 bushels, equal to 1,402,384 tons, when the fact is, Tuscarawas county has not produced 1,402,384 tons of coal altogether in the past 10 years, and last year the output did not exceed 250,000 tons.

In presenting these facts, no reflection is intended, either against the present Secretary of State, or of any of his predecessors in office; the comparison is made simply and only for the purpose of showing the; present careless and inaccurate manner in which statistics are reported to the Secretary of State by the township assessors. The assessors are, no doubt, in many instances, denied access to the facts, and do the best they can under the circumstances. But statistics are worse than worthless, if they are not correct, while they are of inestimable value to a state or nation when they are accurate; and provision should be made, by law, to have accurate returns at whatever cost of time and labor, or all effort for their collection should be abandoned.

It will be observed that the output of the State for the year 1874 is placed in my annual report at 3,267,585 tons, and that the report for the fiscal year ending May 31, 1879, shows 6,437,725 tons, the output being doubled within six years. As known, 1874 was the first year of the panic, by which the mining industry of the State became depressed as, it never had been before. This is not a fair comparison of facts as regarding the annual increase in the coal trade of the State, for if we go back to 1873 we find that 5,450,028 tons were raised. During the panic, however, which lasted from 1874 to 1879, there were no new developments in the coal fields of the State, and the mines in operation in 1874 did not work two-thirds of their time, until the summer of 1879.

The output for the year 1880 will, as I have said, exceed 7,000,000. During this year four new coal fields have been opened, namely: the Coalton coal field, of Jackson county; the Corning coal field, of the Sunday Creek Valley; the Del Roy coal field of Carroll county, and the Wheeling Creek coal field, along the extension of the Cleveland, Tuscarawas Valley and Wheeling Railroad. The output of these new districts will not, however, add to the production of the State for 1880 more than 350,000 tons; because, with the exception of the Coalton region, the other new coal districts were not fairly ready for business before the middle of Autumn. The increased output this year over 1879 is largely due to the unwonted activity of the established districts. Should times continue prosperous for some years to come, the increase in the coal trade of the State will be greater far than it ever has been before. Next year the mining facilities will be such that 12,000,000 tons could be raised and sent to market.

The number of fatal accidents which occurred in the mines of the State during the past 12 months, that is, from November 15, 1879, to November 15, 1880, is 22. Taking the output of the mines from June 1, 1879, to May 31, 1880, namely: 6,437,725 tons for comparison, there was one (1) life lost in the mines for every 292,624 tons of coal mined, which is perhaps a better showing as to safety than that of any other State in the Union, or any nation of Europe. In 1874 there were 30 fatal accidents in the mines of Ohio, which was then computed to be one death for every 127,333 tons of coal mined, the output for that year being estimated at 3,820,000 tons. A subsequent estimate, however, after fuller returns were made in answer to the circulars sent out to the mining companies, placed the production for 1874 at but 3,267,585 tons, which made the death list one fatal accident to every 108,919 tons mined. The same year the reports of the British Inspectors of Mines showed one death to every 134,251 tons raised. As no unusual accidents happened in the mines of Ohio that year, and as several dreadful explosions occurred in British mines, the startling fact was demonstrated that notwithstanding the comparative freedom from fire-damp of our Ohio mines, and the periodical explosions which produce such heart-rending calamities in British coal mines, the death list was for that year greater in Ohio than in England, and greater still in Pennsylvania than in Ohio. Explosions of fire-damp, though in themselves most fearful, do not produce more than one-sixth the amount of fatality consequent in British coal mining. It is the ever-recurring falls from roof and coal in the working places of the miners where the death list of mines is mainly made up. As these accidents occur singly, public attention is not drawn to them, as in the case of fire-damp explosion.

In the following year (1875), twenty-four fatal accidents occurred in the coal mines of Ohio, the output of the mines amounting to 4,864,259 tons, which was one death for every 202,667 tons of coal raised, a very marked gain as to safety, compared with the first year of official supervision of the mines by the State. The same year the death-rate increased in British mines in proportion to the output of coal, there being one death for every 118,730 tons raised.

In 1876 only 13 fatal accidents occurred, but this year the production fell to 3,500,000 tons, causing one death for every 269,999 tons of coal mined.

Next year (1877) 30 miners lost their lives in the mines of the State, the coal output being 5,250,000 tons, which made one fatal accident for every 175,000 tons of coal produced. This year the death-rate was unduly increased by a locomotive being taken into the Brookfield mine, in Trumbull county, against my orders and in defiance of all rules of common sense, by which 7 miners lost their lives at once, being suffocated by the gases from the locomotive. As during the years 1878 and 1879, no attention was paid to mining casualties, or to the coal production of the State, a further comparison of results cannot be made until the present year, when the number of fatal accidents was 22, and the coal production of the State 6,437,725 tons, producing, as already stated, one death for every 292,624 tons of coal mined.

These gratifying results are not claimed as due to any unusual vigilance of the Mine Inspector, but as the results of the existence of the mining law, the provisions of which produced caution and reflection on the part of all in any manner connected with coal mining. The law has oppressed none; it has saved many lives; it has not added to the cost of mining, and it has indirectly aided in gradual, but sure, improvement in the art of the working and ventilation of mines.

The whole number of persons employed in and around the coal mines of the States, including mines that work less than ten men, as shown in the table, amounts to 16,972, of whom about 90 per cent. work under ground, ten per cent. work on top, such as topmen, blacksmiths, engineers, firemen, dumpers, trimmers, haulers, etc. The number employed in the mines which work more than 10 men at once, and consequently come within the provisions of the mining law, is 1350. At the end of this report I have made a tabulated statement, by counties, of the names of the mines, names of operators, post-office address, etc. The first table, made six years ago, has, owing to the increase of new mines, and the exhaustion of a number then in operation, become worthless. Although the law requires the person in charge of a coal mine to notify the Inspector forthwith on the occurrence of any fatal accident, there is great neglect on the part of bosses in doing so. There is no penalty in case of refusal or failure, and many of the accidents, serious and fatal, are collected by myself during official visits to the mines, or are furnished by the miners on request from me.

The law providing the means of securing the health and safety of persons employed in the bituminous mines of Pennsylvania was enacted April 18, 1877. Under this law the bituminous coal fields of the State were divided into three districts, in each of which one mine inspector was appointed, charged with the execution of the law. During the past two years the mine inspectors have endeavored to collect the annual output of their respective districts, but the returns made to their circulars have been very meager, the mine owners evidently not yet having got over their sulk over the passage of the law. The inspectors have, from such returns as were received by them, made estimates of the coal production and the number of persons employed in and around the mines of their respective districts, but their estimates are unquestionably far too high. Fifty per cent. deducted off their estimates would approximate the facts as to the output of the mines.

The coal production of Great Britain doubles itself every twenty years; in the anthracite fields of Pennsylvania, the output is doubled every ten years. This is probably about the ratio in the bituminous fields of that State, as it is of Ohio, and other western mining States of the Union.

LABORS OF THE MINE INSPECTOR.

I commenced the work of inspecting the mines of the State in the latter part of February, my commission bearing date February 12, and have been engaged ever since, when not otherwise employed with office work, in visiting and inspecting mines to see that the law was enforced and obeyed. Two mines situate in the Steubenville district, namely: the Mingo shaft, and the Rush Run shaft, had each but one opening when the mining law went into operation in 1874. The owners of the Mingo shaft, in compliance with the requirements of the statute, reduced the working force of the mine to 10 men, and as no second opening was made during my former term of office as Mine Inspector, no work was done in the mine, except driving entries and working a few rooms. The Rush Run Shaft Company also reduced the working force to 10 men. Subsequently the proprietors of this mine increased the working force to 30 or 35, and finding no disposition manifested on their part to make a second opening, I asked the proper court for an injunction to restrain the owners from working with more than ten men at once until a second outlet was provided, which the court immediately granted (May 18, 1877).

On assuming charge of the office in February last, I learned during a visit to the Steubenville district, that the Rush Run shaft was being operated with a force of men exceeding ten in number, and in making inquiry of the attorney employed to prosecute the case, was informed that the injunction was still in force against that mine. I directed the attorney to notify the owners of the fact that they must respect the statute, and to cause their arrest in case they continued working the mine contrary to law. It seems that some time in 1879 the mine had changed ownership, and the new proprietors, in coming into possession, were not aware of the injunction.

The Mingo shaft also had been working, for some time before my appointment, with a greater force than 10 men. On calling the attention of the Secretary and Manager of the company to the fact, the working force was reduced to conform to the requirements of the law.

For several months after assuming duty, complaints were sent to the office weekly, from one mine or another, about defective ventilation. Every communication received was promptly attended to; the mines complained of were visited and inspected, and assurances given
necessary improvements would be made to provide good air.

This isolated work took up much of my time, so that
to make a complete circuit of the mines of the Stat
however, has been visited, some of them several ti

duty, and I am glad to be able to say that there is better ventilation prevailing in the mines, and greater satisfaction existing among the miners, than when I assumed duty.

After having visited the mining districts of the State, and satisfying myself, by investigation and inquiry, as to the condition of the mines, the following circular was issued from this office and sent to the various mining companies, and to representative working miners:

OFFICE OF STATE INSPECTOR OF MINES,
COLUMBUS, OHIO, *June* 17, 1880.

To the Mine Operators, Mine Superintendents, and Working Miners of Ohio:

The undersigned, appointed Mine Inspector by Governor Foster, on February 12th last, has, since assuming duty, visited the various mining districts of the State, and finds by investigation and inquiry, that the mining law, in many of its most important provisions, is not being respected and obeyed. The attention of all concerned is respectfully but earnestly called to the following facts:

Defective ventilation prevails in many mines, over part or the whole of the working places, frequently to such an injurious degree that the combustion of the workingmen's lamps can only be maintained with difficulty. In some mines there are no means provided for giving motion to the air, and where furnace or other ventilating power is applied to renew the circulation, the air-ways are frequently too far behind, while faulty stoppings and badly hung doors, further prevent the circulating currents from extending to the working faces, where they are so greatly needed, and are required by law. Section 298, chapter 9, of the revised statutes, volume 1, requires that "the owner or agent of every coal mine, whether shaft, slope or drift, shall provide and maintain for every such mine, an amount of ventilation of not less than 100 cubic feet per minute per person employed in such mine, and as much more as the Inspector may direct, which shall be circulated to the face of each and every working place throughout the mine."

Many of the maps or plans of the mines of the State now in this office, have not been extended for several years. Owners and agents of mines are requested to forward, as soon as practicable, plans of the workings of their respective mines. The maps and plans in this office will be returned upon application of the respective proprietors, or their agents, for the purpose of extending the surveys up to date.

Men and boys are in the habit of riding up slopes and shafts on loaded cars, contrary to law. This practice must cease. All future offenses will be dealt with as provided by law.

Many boys under 12 years of age have been, within the past year or two, taken into the mines to work, contrary to the provisions of the statute. Agents of mines are hereby notified that all boys under 12 years, and between the ages of 12 and 16 years, if they cannot read and write, must be removed from all mines under the management and control of such agents, in accordance with section 302 of the revised statutes, which reads as follows: "No boy under 12 years of age shall be allowed to work in any mine, nor any minor between the ages of 12 and 16 years, unless he can read and write, and in all cases of minors applying for work, the agent of such mine shall see that the provisions of this section are not violated." Section 4024 of Ohio school laws, 1880, further provides, that " no manufacturer, owner of mills or mines, shall employ any child under 14 years of age, during the established school-hours of the locality, unless such child has attended some common or private school for the term of at least twelve weeks during the school year next preceding the commencement of such employment, etc."

The law requires the person in charge of any mine where a fatal accident occurs, connected with the working of such mine, to give notice forthwith, by mail or otherwise, to the Inspector of Mines, and to the Coroner of the county in which such mine is situated. This provision of the act is in many instances disregarded by mine bosses. A strict compliance with the spirit of this important section is requested and expected in future.

As some changes in the mining law have recently been made, the various sections arranged under their proper headings, copied from the revised statutes have been printed, and together with a copy of this circular, will be mailed to every agent and mine owner, or company, doing business in the State. Several copies of this circular and law will also be sent to every mine coming within the provisions of the statute. Miners are requested to see that a copy of each is posted up in a conspicuous place at the mine, so there may be no excuse for any further violation of the law.

All the provisions of the law will be faithfully and impartially enforced, so far as it is in the power of the Inspector to do so.

ANDREW ROY,
State Inspector of Mines.

THE COAL FIELD.

The area of the coal measures of the State has been very accurately defined in the published reports of the late Geological Survey. Regarding the structure and resources of the coal-bearing strata, however, there is much to be learned, for on these important questions every member of the geological corps seemed to hold different, and often mistaken views. The published sections of a district, and the conclusions rendered as a result, with regard to the identity of strata taken at different points, when made by different members of the corps, are often so contradictory as to throw discredit in the whole work. For example, Professor J. J. Stevenson and the late E. B. Andrews, who reported in Belmont, Harrison and Guernsey counties—Professor Stevenson working south and Prof. Andrews north of the Baltimore and Ohio railroad, arrived at strangely different conclusions regarding the structure of the strata in this part of the coal field. Prof. Stevenson insisted that the three seams above the Pittsburg coal at Bellaire coalesce with the Pittsburg coal in the western part of Belmont county, while Prof. Andrews declared that all the four beds of coal in question were found in the same order and place in the western part of Belmont county as they occupy on the Ohio river at Bellaire, and he could find no coalescing of seams in going from the Ohio river to the west.

In the third volume, Geology, there are two reports of the Hocking Valley district—one by Prof. M. C. Reed, and the other, a supplemental report, by Prof. E. B. Andrews. In these reports Prof. Reed is quite positive that the Carbondale coal of Athens county is not the great vein or Nelsonville coal, but a seam 50 feet higher up; while on the other hand Prof. Andrews calls it, as he had hitherto done in former reports, the Nelsonville coal. Prof. Reed says there is a great deal of controversy in regard to the identity of the Carbondale coal. None of the Ohio geologists, who have examined this coal, except Prof. Reed, have questioned its identity with the Nelsonville coal, and there is no controversy on the part of practical men on the subject, all being agreed that it is the Nelsonville coal.

The true horizon of the grey limestone, in the southern portion of the coal field, was, during the progress of the survey, a matter of grave doubt. Prof. Andrews, in the earlier reports, located it above the Nelsonville coal, while Prof. Orton, in the later reports. has shown that it lies not only below the Nelsonville coal, but below coal No. 5, a still lower seam of the series.

In the north-eastern part of the coal field bordering the Pennsylvania line, there is a sad lack of harmony between the Pennsylvania and Ohio geologists—Prof. Lesley, Chief of the Pennsylvania Geological Survey, insisting that the Sharon coal of the Shenango Valley, which is the equivalent of the Brier Hill coal, is of sub-carboniferous age, while Dr. Newberry, Chief of the Ohio Geological Survey, is positive that it is a true coal.

The recently published report of Prof. White, on the geology of Lawrence county, Pennsylvania, also boldly asserts that the published sections of the lower coal measures of Ohio leave out 250 feet of strata, including two beds of limestone, and two seams of coal.

These conflicting statements, which are but a few of many of similar import, will show the unsatisfactorily work of the geological survey; yet, notwithstanding these facts, the survey is a great work, and was well done, considering the limited period of three or four years over which it extended. A perfect and complete geological survey of the State could not be made in less than twenty years, perhaps not in less than fifty years; for as our mineral resources are developed from year to year, new problems will arise, which, even with the ever increasing lights of science, will tax the mining engineer and geologists to solve. A great mistake was made when, in discontinuing the late geological survey of the State that one of the members of the corps was not permanently retained as State Geologist. The interests of the State require that the geological survey should be resumed and continued for at least five years longer, and that the reports, already published, should be revised and corrected.

Many of the unsettled facts in controversy between the members of the geological corps come under the notice of the Mine Inspector during official visits to the mines, and in former reports I have discussed with great freedom a number of the points in dispute, and have materially aided in solving them. If the geological survey is not continued, and provision is not made for the appointment of a permanent State Geologist, the annual reports of the Mine Inspector might be improved by empowering and requiring him to report upon the various mineral strata, and to note the progress and development of the mineral resources of the State.

Prof. Edward Orton, of the geological survey, whose reports are the most valuable, because the most accurate of any member of the geological corps, in a paper published in the Secretary of State's report for 1879, reviewing certain points in the geology of Eastern Ohio, speaking of the manner in which our coal strata were built, says, (page 616):

"Each coal-seam grew in a marginal marsh, comparatively few miles in breadth. To look for the lowest coal under the Nelsonville seam, for example, or for the Nelsonville coal under the Pittsburg seam, is, as a general rule, to look for the living among the dead. It would be a geographical accident, and an unusual one, that would allow the marshes of such distant seams to occupy the same area. Subsidence of the interior region cannot be dispensed with, but the steady contraction of the gulf by the slow elevation of its border, seems to me essential to an explanation of the facts involved."

The theory that the interior of the great coal marsh, which now forms the Allegheny coal-field, was a shallow sea during the deposition of the vegetable material from which the coal-beds are derived, and that the coal-forests grew only on the border of this sea, is a favorite one with some of our geologists. But such practical facts as we have at command seem to me to warrant a different conclusion. That there were water-spaces in the interior of the great marsh, as well as upon its borders, while the coal-beds were forming, will admit of no dispute. There are many wants in the lower coal-seams of Ohio, the result of water-spaces; but the Nelsonville coal, No. 6, the steadiest of all our coal-seams, except the Pittsburg coal, extends not only across the State, but far in the interior of the great coal-field; and, perhaps, stretches across its whole breadth, with, no doubt, occasional wants in the central portions, as on the margin of the great plain. The Nelso coal is the Steubenville coal of Jefferson county, 600 feet ab the Pittsburg coal is found in the hills, "the living and the dead" both alive and well, and the lower, the richer and the better coal. Forty-four feet below the Steubenville coal, a shaft has been sunk in the floor of the rolling-mill pit into another seam, and still lower seams are known to exist of good, workable thickness. The two seams, the Pittsburg and Nelsonville, stretch westward to Cadiz, until the Pittsburg is lost in air. At Bellaire, in Belmont county, the Pittsburg seam comes down to the water-line of the Ohio river. The Nelsonville or Steubenville coal has been pierced through by boring nearly 600 feet down, while, in the hills fronting the river, 6 to 8 different and well developed beds of coal, ranging from 2 to 5 feet of thickness, are met in the 500 or 600 feet of strata which there overlie the Pittsburg coal. That the Steubenville coal, found by boring at Bellaire, is continuous from Steubenville to Bellaire, is proved by the Mingo, Rush Run and La Grange shafts, all sunk into the Steubenville coal; and there can be no question as to the Pittsburg coal following and covering it all the way, since that coal is opened and mined in 50 places between Steubenville and Bellaire.

Again, at Pomeroy, in Meigs county, where the Pittsburg coal is level free, the Nelsonville coal has been struck 500 or 600 feet below it at many points in the salt-wells of the district. And in the Hocking Valley district, where the high lands of Athens county inclose the Pittsburg coal, the Nelsonville coal is met directly below; also, coals No. 5, No. 4, No. 4*a*, and No. 3, showing that the lower and upper coals are not only found together, but probably stretch for 30 miles across the coal-field. The Pittsburg and Nelsonville coals our great and persistent seams, are, wherever the strata are deep enough to hold both beds, "like Juno's swans, still they are coupled and inseparable" over the whole coal area of the State.

In the central portion of the great Allegheny coal-field, where the lower coal measures are buried deep out of sight, the richness and extent of the upper coal measures will supply the demands of trade for centuries to come. It is, therefore, of no great importance in a commercial point of view, and is mere matter of speculation in a geological point of view, as to what particular strata compose the lower measures there. In the coal-fields of Maryland and West Virginia, however, situated on the Potomac river where the strata, to a greater or less extent, became involved in the upheaval of the Allegheny mountains, the coal measures are torn in two, from top to bottom, exposing to view 1,200 to 1,500 feet of thickness of strata. There, all the seams are seen in place, from the lowest, resting on the conglomerate to the highest, several hundred feet above the Pittsburg seam. In those mining regions, as in Ohio, many wants or faults are met, the result of various causes; but there is no evidence whatever of the existence of an ancient retreating sea, along whose shores the numerous coal beds were built above each other, like the steps of an inverted stairway.

That the lowest coal of the State series is not found under the Nelsonville coal, is due to its limited area in the deep and narrow basins in which it was formed. This coal, even on the extreme margin of the coal field, is not spread over one acre in a thousand where it is due higher up in the measure; the coals answering to No. 3, 3*a* and 4, are met with, not only below the Nelsonville coal, but below the Pittsburg coal, and still other higher coals of the upper measures. These lower coals are not always of mineable thickness, and they are frequently wanting altogether, but they are as often missing on the out-crop or edge of the coal field, as they are in the more eastern portion of the basin.

As regards the lower coal, no one can say positively that it does not exist under the Nelsonville coal, or even under the Pittsburg coal, because it has never. been searched for to any extent immediately below these seams. It has been followed from its line of out-crop in Trumbull county, southward along the dip of the strata, until it is covered with nearly 300 feet of strata, and according to Dr. Newberry, Chief of the geological survey, the Nelsonville coal is not more than 300 feet above the lower coal, though my own calculations make the distance between those beds 400 feet or more.

All of the lower coals of the State series seem to have been formed in hollows or basins, scooped out of an originally level plain anterior to the deposition of the coal vegetation. Any intelligent person can satisfy himself of this fact by an examination of the mines opened on the lower measures.

The Nelsonville coal is by far the steadiest of the series, but it, too, is frequently found imbedded in basins of quite limited area.

Whether the upper coals were also deposited in basins, in the same manner as the lower beds, is not known, because very little mining has yet been done on any of them, except the Pittsburg seam; this bed is, however, everywhere found stretched upon a comparatively level floor, and is the steadiest and most persistent of all our coals. The basins to which I have alluded above were deepest and narrowest in the lowest bed. As the lowest coal was one of the first opened and mined in the State, and as it is generally of very superior quality, it has been sought for and mined with extraordinary vigor wherever it could be found. The shape and line of direction of the basins in which this coal lies imbedded, are well understood, and have been described at length in former reports of this office, and by Dr. Newberry, in the geological reports of the State. The coal is sunk deep into the conglomerate, and sometimes into the upper surface of the Waverly sandstone, which underlies the conglomerate, but it is, notwithstanding, unquestionably a later creation of geology than the conglomerate.

All the coals which occur between the Brier Hill and Nelsonville coals, although often found in basins or troughs, not unlike the basins or troughs of the Brier Hill coal, extend over much greater areas. The mines opened on these intermediate coals, in being worked to the edge of the deposit, very frequently become exhausted by "cut-offs" on the hill-sides, or, if the seam holds its place in ascending the hill, it grows gradually thinner until it disappears like a feather edge. The sudden cut-offs on the hill-sides are, no doubt, the result of shore waves which lashed the sides of the peat marsh during the early subsidence of the land. All the wants of the lower coals are not understood as occurring by reason of the basin or trough-like position in which the coals were formed. There are wants which are evidently the result of water spaces in the old marsh, in which no coal vegetation grow, and, no doubt, great areas of now barren ground have been made so by evasion or denudation.

In the report of Progress of the Second Geological Survey of Pennsylvania, volume 22, page 52, Prof. I. C. White furnishes a "Typical Section" of the conglomerate or interconglomerate measures of Lawrence county, in that State, which includes five different beds of coal, and 260 feet of thickness of strata. This "Typical Section", consisting of alternating beds of coal, fire-clay, sandstone, shale, limestone and iron ore, differs in no sense from any general section of the strata, either in the upper or lower coal measures of Pennsylvania or Ohio. Prof. White says that a glance at the section would probably lead one to place it in the productive coal measures instead of the conglomerate, without a knowledge of the section which comes in above. In my judgment, there are much better reasons for asserting that all the coals below coal No. 7 are, with these incumbent strata, interconglomerate coals, since a well marked and persistent conglomerate rock covers coal No. 7 over many parts of the coal field, while there is never, either in the Shenango or Mahoning Valleys, with the exception of thin and rare patches of conglomerate forming the roof of the Sharon coal on the margin of the coal field, any conglomerate from the Sharon coal up to coal No. 7. Prof. White's section of the Foster shaft in Mahoning county, Ohio, wherein a pebbly rock is located, as composing the lower eight feet of the massive sandstone in the shaft, is *not* a conglomerate, and contains no pebbles, but is part of one of the ordinary sandstones of the coal measures. A mile west of the Foster shaft this massive sand-rock thins out altogether, and is replaced by beds of limestone, coal, fire-clay, and masses of shale.

Many of the sandstones of the coal measures, which are deposits of sand brought over the old coal marsh by currents of water in rapid motion during the subsidence of the land, are not continuous, and they are met on every horizon. Sometimes they seem to have been deposited in quiet waters, but frequently they have come over the coal marsh in currents of such violence as to evade the muddy sedements below for 20 to 30 feet in depth, and to cut into the coal forming the horse-backs of the miners. These rocks are entitled to no special name, like coal and limestone beds, because they are never continuous nor ever occupy special geological levels on extended plains like the coals and limestones. In a dozen drill-holes, selected at random from my own field-notes, as a coal-driller from an area not exceeding one hundred acres of territory, the first hole cut through six different beds of sandstone, ranging from one to ten feet in thickness; the second hole, a hundred and twenty yards distant, met no sandstone, while the third had 100 feet of solid sand-rock on a lower geological horizon from any of the beds met in the first hole, and so on throughout. All the shafts of the Mahoning and Shenango Valleys show the above varying material.

The conglomerate and upper Waverly rise high above the geological horizon of the Sharon coal, and even above the lower Mercer limestone, in the immediate neighborhood of the coal basins in both valleys, presenting the remarkable fact of the older strata becoming the upper or higher strata; *and it is this fact which confuses the geologists.*

We will take the Foster shaft as illustrating the manner in which these lower coal strata were built up in the troughs of the sub-carboniferous strata. The shaft, as shown in Prof. White's sections, is 240 feet deep, the coal at the bottom of the pit being nearly five feet thick. Not 125 yards from the shaft the Waverly sandstone, "the bottom rock" of the coal drillers (there is no conglomerate in this immediate neighborhood), rise up within 80 feet of the surface of the ground. The drillers, in boring for coal, stopped at this depth, finding no coal, while at the shaft, already stated, the coal is 240 feet below the surface. Other holes showed nearly equally variable conditions. Some of the holes were run down into the "bottom rock" to make assurance doubly sure, but nothing was met save the alternating layers of the fine-grained blue sand-rock and soapstone, which in the Mahoning and Shenango Valleys constitute the upper Waverly for at least 200 feet. The experienced driller can tell, by a glance at the *debris* of his pump, as soon as he strikes through the "coal material" into the "bottom rock." The characteristic fossils of the coal measures, and the plants of Waverly shale, are no surer guide to the intelligent paleontologist.

Suppose that, after the close of the carboniferous era, the deep valley through which the Shenango river flows at Sharon had became filled up to the level of the highest adjoining lands by a deposit of creteceous strata of the Mesozoic age, we would now find these secondary strata reaching down through the conglomerate into the Waverly, while on both sides of this deposit, on a higher horizon, the true coal measures would be met.

This is exactly the position of the strata, with respect to the Sharon coal, and the older sub-carboniferous rocks. *The newer strata of the lower coal measures, although occupying lower ground, are, notwithstanding, a later creation of geology.* No fossils have ever been found in the strata directly overlying the lower coals, save the plants of the coal measures. It is always at points where there is neither coal nor coal material that fossils of the Cuyahoga shale are revealed in the supposed inter-conglomerate coal-bearing rocks. This peculiarity of the strata has deceived the Ohio geologists, as well as those of Pennsylvania.

The Brier Hill mines, from which the Mahoning Valley block coal derives its name, were opened (they are now worked out) directly upon the Mahoning river, 2 miles north of Youngstown. As we ascend the Mahoning from this point, the Waverly rocks rise high above the coal level. The Ohio geologists declared, in consequence, that no coal existed north of Brier Hill. Afterwards, however, a coal-driller, who had never heard of the geological survey, having some leisure time, drilled down 80 feet and found the Brier Hill coal full 10 miles north of the Brier Hill mines. Had the hole been located 100 yards to the west of where it was put down, the Waverly sandstone would have been met within 10 feet of the ground. It was with some difficulty that the driller could induce any of the coal-operators of the valley to go in with him to open the mines after he found the coal. The swamps, in their north and the north-eastern course, were thus accidentally discovered, and hundreds of thousands of tons of coal were made available for the purposes of commerce.

In the mining districts of the Mahoning Valley of Ohio and Shenango Valley of Pennsylvania, coal No. 2, of the Ohio geological survey, lies from 25 to 60 feet above coal No. 1,—the Sharon coal. It ranges in thickness from 8 to 18 inches, is much more persistent than the lower coal, and is rarely, if ever, absent where No. 1 is present, except where it is cut away by sandstone horse-backs, which usurp its place. The two coals show the same wavy character, though in No. 2 the swamps are less abrupt. Although No. 2 is often absent over large areas where it is due, it occupies much greater areas than the lower coal, and, when wanting, it is nearly always from the same cause that No. 1 is wanting, namely: by the coal rising and thinning out on the hill-sides; the bottom rocks come up high above the horizon of the coal and spread themselves in extended plains, forming barren ground. An illustration of this fact is well shown in a hole drilled on the lands of Jesse Hoagland, on the summit of Keel Ridge, in Mercer county, Pennsylvania. The hole was bored to a depth of 235½ feet, and passed through the "coal material" into the "bottom rock," at a depth of 168½ feet, the lower 66 feet being cut in the Cuyahoga shale of the upper Waverly. Prof. White, in his report of Mercer county, Q. Q. Q., page 108, publishes the journal of the coal-driller, and intimates that, because the hole did not go down to the level of the Sharon coal, the question of the existence of this coal was not definitely determined. The learned Professor does not seem to be aware of the unconformable character of the strata. Practical men have long found out, by dear experience, the utter hopelessness of finding coal in the Cuyahoga shale, whether above or on the level of the Sharon coal. Occasionally there is some farmer, who, believing that he has coal, will be satisfied with no test, unless the holes are bored down to the coal level, no matter what material is met. As the money is his own, no one has, perhaps, a right to complain of the manner in which he spends it; but it is, indeed, melancholy to see men of science encouraging such folly.

THE MINES.

The coal beds of the State series were named by Dr. J. S. Newberry, Chief of the late geological survey, from No 1 up to No. 13. During the progress of the survey new beds were discovered, which were named No. 3*a*, No. 6*b*, etc., as they were found imbedded between seams already enumerated. These names, however, though suited for the purposes of the geological student, were not well adapted to the necessities of the coal trade, and were never generally adopted by the coal producers. The names, by which the coals in course of development are known at the mines and in the markets, are usually called after the village, or valley, or creek, or district near where the mines are located, as, for example, the "Mahoning Valley coal," the "Massillon coal," the "Sunday Creek coal," the "Jackson coal."

The number of coal mines in the State which come under the provisions of the mining law amount to nearly 300, and are of three kinds —drifts, shafts and slopes. The system of working everywhere in use is known as pillar and room practice. An effort was made some years ago to introduce the long-wall practice in two or three mines along the line of the Niles and New Lisbon Railroad, but it was soon abandoned. The workings of a thin seam of coal on the property of the Glasgow-Port Washington Iron and Coal Company, in Tuscarawas county, was laid out on the long-wall plan a year ago, but when the furnaces of this county went out of blast in the spring of this year, the mine shut down.

There are many modified plans or systems in use in working by pillar and room in the coal mines of the State, according to the varying conditions of the different coal districts in which the mines are opened. The general practice in drift-mining, especially where the cover of the coal does not exceed 100 to 150 feet, is, to work with as wide rooms as the roof will permit, and leave small pillars or ribs of just sufficient strength to maintain the superincumbent strata in place, and prevent a crush from overrunning and destroying the mine workings. By this practice about 66 per cent. of the coal is won in the first stage of working. In drawing the pillars or ribs after the mining territory has been pushed to the line or boundary, only a small proportion of the coal is recovered, as the pillars, barely able to sustain the overlying strata in working forward, are overrun by the crushes, which always accompany pillar-drawing. Thick coals require stronger pillars for the support of a mine than thin seams, when all other conditions are equal.

The general practice is to leave the pillars too weak, rather than too strong, in drift-mining districts, because heavy pillars add to the cost of mining the coal in working forward. Leaving pillars of ample strength, however, always pays in the end, since more pillar coal is got in working backward, and the danger of a crush, which too often overruns a mine where the supports are weak, is prevented. Coal lands, however, are abundant and cheap, and the cost of making a new opening for a drift-mine amounts to little; hence, the desire to work out as much coal as possible by the cheapest method, rather than follow approved plans, looking to the ultimate recovery of all the coal in the hill.

The manner of mining in the shaft mines is similar to that practiced in the drift-openings, except that the pillars are generally left stronger for the supporters of the heavier overlying strata. As in the level free mines, the pillars are too frequently left weaker than good practice would warrant, and the result is seen in the crushes which occur time after time in the various districts. Gradually, but surely, however, improved methods of laying out the underground working of mines are being adopted in every district of the State.

Long-wall mining is much practiced in Great Britain and on the continent of Europe. In Scotland, more than half the mines of that country are operated on the long-wall system; and in the South Wales coal field this method is in very general practice. Its advantages consist in the extension of all the coal of a mine, and in the increased facilities for good ventilation. It may be safely said that with our present wasteful modes of mining by pillar and room, fully 40 per cent. of the coal is left in the mines, after they have been worked over, in crushed and abandoned pillars. It would be to little purpose to point out, in the infant development of our vast mineral resources, the loss which this waste of material will entail upon posterity; still, as there is no excuse for our wasteful modes of working, I consider it a duty to advocate the adoption of every known and approved plan in the working and mining of coal. A number of our coal seams are well adapted to long-wall working, and a fair trial of the system will develop its advantages. Beds ranging in thickness from 3 to 4 feet are best suited to long-wall mining.

The State Line Coal Co., at their mine in East Palestine, in Columbiana county, employs a larger number of underground workmen than are employed in any other mine in Ohio, more than 300 men and boys being employed in digging and loading coal. This mine is situate immediately on the line which divides the States of Ohio and Pennsylvania, and the main gallery of the mine, which runs southward, runs parrellel with the State line.

As the butt-entries, opened from off the main entry, extend to the east and west on both sides of the main entry, part of the workings are in Pennsylvania and part in Ohio. This mine, therefore, comes under the inspection laws of two States, and of a Mine Inspector from each of these States. I inspected the Ohio part of the mine in April last, and the air in a large part of the workings was not good. The butt-entries are all single, and though doors are erected on the mouths of the rooms as soon as they are turned, the working places at the heads of the different butt-entries were thick with powder-smoke. As the butt-entries are only 100 yards apart, and the rooms driven on but one side of these entries, there would be a saving to the company by driving double entries, 200 yards apart, and opening rooms off both sides, since it would cost less to drive airways through the pillar dividing the double entries than suffices for the erection and maintenance of trap-doors at the mouths of the rooms. By this method the advantages in favor of superior ventilation would also be greatly increased. The manager of the works, who is one of the most intelligent and ingenious mining engineers in Ohio, should ponder over this fact.

The machinery in use for hauling the coal underground, and for cleaning the screenings of impurities, displays unusual skill and judgment on the part of the mine management. A stationary engine is erected outside, which operates an endless wire-rope, extending for seven-eighths of a mile along the main gallery of the mine. The empty train of cars is driven along this gallery to the double parting, where the trains are made up. A telephone extending underground to this parting, the first telephone used in a coal mine in the world, facilitates communication with the hauling engineer and the hitcher, and is a vast improvement over the old method of signalling. The loaded train of mine cars, fifty to sixty in number, is made up at the double parting, and as the empty train is delivered on this parting, the loaded train is started outside, and in a few minutes is delivered at the chutes. The washing machinery for separating the slate and other impurities from the nut and slack coal, redeems fully 14 per cent. of the coal output, which formerly was unfitted for any purpose. This coal is purified by a stream of water poured upon it, which carries it through a long narrow trough provided for the purpose. The slate and other impurities in the coal, being the heavier bodies, fall by the way, and lodge in the bottom of the trough.

The mine of the Church Hill Coal Co., situate in Trumbull county, employs, next to the State Line Mine, a larger number of workmen than any other mine in the State. The whole force employed amounts to 342 men and boys, of whom 23 work on top and 319 under ground. The underground workmen are divided up as follows: 285 diggers, 17 drivers, 10 roadmen, 2 trappers, 2 pumpers, 1 furnaceman, 1 hitcher and 1 boss. The top hands are distributed in the following manner: 4 topmen, 3 trimmers, 3 blacksmiths, 2 engineers, 2 firemen, 2 water engineers, 2 dumpers, 1 locomotive engineer, 1 hostler, 1 spragger, 1 snatchboy, and 1 weighmaster. Eight different European nationalities are represented underground, exclusive of native-born Americans, as follows: Welsh, French, Scotch, Italians, Germans, English, Irish and Greeks. There are more Welshmen than of any other nativity; the others are represented as to numbers in the order named above. The Church Hill mine has been running for thirteen years, and is one of the most profitable to the owners of any in this State. The underground workings extend more than a mile from the bottom of the slope. The coal, varying from

2½ to 4½ feet in thickness, is of admirable quality, and though disposed in basins of irregular shape, it rises over one hill and dips into an adjoining swamp, forming a series of basins or troughs without break in their continuity.

WAGES DISPUTES, AND THEIR AMICABLE ADJUSTMENT.

A number of efforts have been made during the past year, between miners and employers, for the purpose of settling the vexed questions of wages without resorting to the barbarous methods of strike; some of these efforts have been successful, while others have resulted in disastrous failure.

ARBITRATION AT MINERAL RIDGE.

During the fall of 1879, when the iron trade was booming, and coal was advancing in price, the miners of Mineral Ridge thought they were entitled to more price than they were receiving, and made a demand on the operators for an advance. The mine owners replied that they could not accede to the demand, that while iron had advanced, their coal market had not. Mr. David H. Davies, one of the most intelligent and conservative miners of Mineral Ridge, then suggested that a committee of miners be appointed to meet the operators for the purpose of discussing the question. If the miner's committee could prove to the operators that an advance in the price of mining was due, the operators would, they said, agree to such advance; if, on the other hand, the operators could convince the miners that no advance was due, then the miners were to continue working until such time as the condition of the market would justify an advance, when the operators would concede to it. A committee of miners met a committee of operators with this understanding, and the question was discussed from every stand-point. The result of this meeting was the establishment of the following basis of prices:

When coal sells for $2.10 per ton—

4	foot	coal to	be	paid	70	cents	per	ton.
3	"	9 inches	"	"	75	"	"	"
3	"	6 "	"	"	80	"	"	"
3	"	3 "	"	"	85	"	"	"
3	"	0 "	"	"	90	"	"	"
2	"	9 "	"	"	95	"	"	"
2	"	6 "	"	"	100	"	"	"
2	"	3 "	"	"	105	"	"	"
2	"	0 "	"	"	110	"	"	"

It was also agreed that with every advance of the price of coal the miners were to receive one-third of the same. A committee of miners and a committee of operators were permanently established, which was to meet together at stated periods for the purpose of discussing and adjusting disputes as they would arrive, the miners meantime to continue working. Many strikes were thus avoided, and a better feeling established between the parties in interest. On the 2d of February, 1880, the price of mining was changed from the selling price of coal to the puddlers' scale, as per agreement by the parties named:

NILES, OHIO, *February* 2, 1880.

It is hereby agreed by, and between the following operators of Mineral Ridge on the one side, and the miners of Mineral Ridge on the other, that said mines shall hereafter be operated as follows:

The price for digging standard coal and ore shall be advanced and reduced the same per cent. as the scale will advance or reduce the puddlers, and no strike shall occur.

This arrangement shall be in force for the year 1880, but may be canceled by either party by giving sixty days notice.

Committee for Miners.
PHILLIP GHARGIL,
EDMUND DAVIS,
DAVID H. DAVIS,
JOHN S. EVANS,
THOS. S. BIRKBECK.

Operators:
HARRIS MAURER & CO.
HOMER BALDWIN.

Toward the close of the year some dissatisfaction arose among the miners of the Ridge in regard to the scale, which resulted in a strike of short duration. At a joint meeting of miners and operators, however, the former friendly relations were restored, and an agreement entered into to be of binding force for the year 1881, of which the following is a copy:

We, the undersigned operators and committee of miners, of Mineral Ridge, Ohio, mutually agree to pay and accept seventy cents (70c.) per ton for mining standard coal, based upon the present price paid for puddling in the Mahoning Valley, viz.: $5.50 per ton, and in case of an advance or decline in the price paid for puddling, we mutually agree to pay and accept a proportionate advance or decline in the price paid for mining, it being understood that the rate of 14 cents shall be the rate

of advance in mining for every dollar's advance in puddling, this contract to remain in force six months from January 1, 1881.

EDWARD NICHOLAS,
JOHN JOSEPH,
EDWARD G. EDWARDS,
PHILIP GHARGIL,
EDWARD DAVIS,
Committee on behalf of the Miners.

W. T. WILLIAMS,
OSBORN COAL CO.,
TOD, WELLS & CO.,
Committee on behalf of the Operators.

CO-OPERATION IN THE SUNDAY CREEK VALLEY.

The Ohio Central Coal Company, which opened up a number of new and extensive mines in the upper Sunday Creek Valley in Perry county during the past summer, conceived the idea of working the mines on a co-operative plan. The miners were to receive one-half the selling price of coal (including that of nut and pea coal) at the mines, and a contract was drawn up and submitted to the miners employed by this company. A number of miners signed this contract; others, who refused, were paid off, and colored miners from Virginia brought to fill their places. The contract was in force only a few weeks, when it was abandoned by the company. This plan of mining created dissatisfaction among the miners of Straitsville, Shawnee and Nelsonville districts, who insisted, that under its provision, the Ohio Coal Co. would enter and hold the coal market by cutting prices, and thus lead to a reduction of the price of digging all over the valley. A number of mass meetings were held by the miners of the whole valley, at Corning, where the mines of the Ohio Coal Co. are located, one of which was of so threatening a character that the sheriff of the county called upon the governor for military assistance, and several companies of state militia were sent to the mines.

The object of these mass meetings of miners was, for the purpose of inducing the colored men to abandon the co-operative method of digging. Failing in this, the old miners became greatly incensed against their sable fellow-workingmen, and determined to get rid of the colored element by intimidation and threats of violence. The action of the miners of the Hocking Valley in proposing, and attempting to carry out so bold and lawless a scheme, can admit of no possible justification or excuse, and the best men among the miners now view this matter in this light. No condition of affairs can arise either in coal mining or any other department of industry, which will justify lawless measures on the part of workingmen seeking the redress of grievances.

This is a free country, but liberty is not license, and the right of laborers, whether white or black, to work upon any terms that may be agreed upon between themselves and their employers, is as sure and sacred a right as that of workingmen to organize trade unions. The power which intelligent combination gives workingmen, under skillful leadership, affords ample protection against the power of capital without resort to lawlessness. The workingman who, in this free country, would advise a resort to lawless measures, or the labor organization which, directly or indirectly, gives countenance to force, are enemies, not friends, of workingmen.

The Ohio Central Coal Co., of Corning, made the following contract with each miner employed, which was the cause of all the trouble:

It is hereby agreed by and between ——— ——— and the Ohio Central Coal Co. as follows:

The said ——— ——— hereby agrees to mine coal for the said company from the date of this contract until August 1, 188-, on the terms and conditions hereinafter named. And the Ohio Central Coal Company agrees to employ the said ——— ——— during said period, if the conduct and services of said miner are in all respects satisfactory, and will pay for such services according to the terms and conditions aforesaid. Said employment during said period to be governed and regulated by the demand for coal and the capacity of the mine. And this contract shall cease and determine whenever coal on the car, at the mine, sells higher than two dollars or lower than eighty cents per ton.

I. The miner shall dig and deliver coal on the car at the face of room, under the direction of the mining boss, and shall be paid for all salable coal dug and delivered as above, during the month, one-half the average selling price on cars at the mine, during such month. The distribution of nut and other coal shall be in proportion to the lump coal dug by each miner. Odd pounds less than one hundred shall be counted against waste and water.

Settlements with miners who quit work or are discharged will be at prices paid for mining during the preceding month, and if the miner occupies any of the leased property of the company, he will give immediate possession thereof, and the balance will be paid him only after the surrender of the possession of such property.

II. Payment.—Miners will be paid on the third Wednesday of each month, for all services performed during the next preceding month.

III. Check-Weighmasters and Accountants.—Miners may, at their own expense, employ and put on check-weighman and accountant, to ascertain that weights and accounts are correctly kept, who shall have all reasonable facilities for the discharge of their duties.

In witness whereof said parties have hereto subscribed their names this ——— day of ———, 188-.

——— ———,
——— ———,
THE OHIO CENTRAL COAL CO.

AGREEMENT ON A BASIS AND SLIDING SCALE FOR THE ADJUSTMENT OF WAGES IN TRUMBULL COUNTY ON THE SELLING PRICE OF COAL.

This arrangement and agreement, mutually entered into as of the 10th day of May, 1880, by and between the Church Hill Coal Co., of Church Hill, Trumbull Co., Ohio, on the one side. and the several miners and employes of said company by their following-named committee, viz. John P. Williams, Thomas Phillips, Daniel Edwards, Wm. R. Thomas and John Kennedy, duly appointed to act for them as per resolution hereto attached on the other side.

Witnesseth, Whereas, said Church Hill Coal Co. are operating their mines at Church Hill, Ohio, (known as the Church Hill mines,) and it is mutually desired that an arrangement as to wages and compensation for mining and labor be made satisfactory and to continue in full force from said date of May 10th, 1880, to April 1st, 1881, so as to avoid disputes, trouble, stoppages and injuries to either parties. Therefore, it is mutually agreed and understood as follows: At the end of each month, all coal mined and sold by the company from their said mines is to be computed and averaged per ton on the price at which all is sold; and when said average price per ton of sales is found, one fourth part of this average shall be the basis price for mining said coal to the tonnage miner; and for any coal as to thickness and condition not coming under the head of basis price, then the price for the mining of such coal shall be arranged by and between the company's bank boss and the miner or miners working such coal; that is, any advance paid over and above the basis price shall be agreed upon by and between the bank boss and the miner or miners, as has been done heretofore. The basis price paid per ton for mining is also to regulate price of yardage.

The price paid full day laborers, such as roadmen and drivers, shall be governed by the advance or reduction from the basis price paid for mining, as heretofore, and for any other day labor the price for such work shall be arranged, as heretofore, by the superintendent, or, in his absence, the bank boss shall act for him, and arrange such wages, as heretofore.

It is mutually understood that during the time this contract specifies, the miners and the employes are not to stop work and come out in a body, but shall comply strictly and honestly with the provisions and agreements of this article, reserving for themselves, severally, the right to quit work and go elsewhere for employment at any time they may see proper to do so, but nothing in the above is to be so construed as to prevent the said company from discharging any miner or employe at any time.

It is further understood that any miner or miners, employe or employes, violating this contract in any way shall be discharged from said mines.

It is understood when the average sales per ton goes below the sum of two dollars, then this contract is not to be binding on either of the parties herein named.

Signed on behalf of the Church Hill Coal Co. employes by their committee:

JOHN P. WILLIAMS, *Pres't.*
THOMAS PHILLIPS, *Sec'y.*
WILLIAM R. THOMAS,
DANIEL J. EDWARDS,
JOHN W. KENNEDY,
CHURCH HILL COAL CO.

CHURCH HILL, OHIO, *May* 19, 1880.

We, the employes of Church Hill Coal Co., met on the above date, and adopted the following resolution: Resolved, that we authorize our committee to sign the above agreement on our behalf.

(Signed) CHURCH HILL MINERS.

WORKING UNDER AN ANNUAL CONTRACT.

A strike of a novel character took place at the mines of the Wheeling Creek Coal Co. in the early part of November. The company employed a new pit boss; as the old boss was a favorite with the diggers, they struck and demanded his reinstatement in office. The coal company, amazed and indignant at such a high-handed proceeding, shut down the mines and notified the miners that work would not be resumed again for six months. After a month's idleness, during which the employes in and around the mines lost $5,000 in wages, and the company lost their contracts in the coal markets, the miners discovered that they had made a mistake, and withdrew their claim to dictate who should boss the mine. Before resuming work, however, the manager submitted a contract for the signature of the miners, of which the following is a copy:

OFFICE OF WHEELING CREEK COAL CO.,
BRIDGEPORT, O., *November* 29, 1880.

We, the undersigned miners, drivers and laborers, agree to go to work for the Wheeling Creek Coal Co., and hereby pledge our *sacred word of honor* that we will do all in our power to subserve the best interests of the company, as well as ourselves—that we will not engage in any strike, or do any act that will cause a suspension of the works, without giving (through our committee) ten days' *written* notice to the manager of said works. That we will appoint a committee, consisting of three reasonable miners working in said mine, that shall be satisfactory to the company, who shall have full power to settle all disputes of any kind between ourselves and said company; that we will attend no meetings in relation to the business of mining, unless called by said committee or the officer of the company. We further agree that no meeting shall be called during working hours while the mine is running.

The above contract was signed by the miners, and work resumed on the first of December. I trust that all future troubles may be settled between the miners' committee and the Manager, without a strike

THE SLIDING SCALE ON THE SELLING PRICE OF PIG-IRON.

The Cherry Valley Iron Works, situated at Leetonia, in Columbiana county, have a contract with their diggers on a basis and sliding scale. The coal is of a caking character, and is converted into coke, and used in the blast furnaces of the company. The seam of coal is 30 inches thick; the coal is loaded and sent out as it comes from the miners' pick, no screens being used at the mines. The following is the basis and sliding scale:

When pig-iron sells for $16 per ton, the miners receive 48 cents per ton for digging; for every advance of $3 in the selling price of iron, the miners are advanced 5 cents per ton until iron rises to $50. The scale is so arranged that, until iron advances above $1.50 a ton the miners receive no advance, but when iron rises in price to $1.51, the 5 cents per ton is given the miners. This contract was entered into between the parties in iterest on the 1st of March, 1880, and is binding for one year. It has been faithfully adhered to by both parties, and seems to give very general satisfaction.

THE SLIDING SCALE ON THE SELLING PRICE OF NAILS.

The following agreement, though referring to but one company, was made by several others in Lawrence county, and is still in force:

IRONTON, O., *May* 29, 1880.

To John Grant and Edward Edwards, Committee of Belfont Coal Miners:

GENTLEMEN: We will pay for mining coal at our mines as follows:

When our card price for nails is $3.25, we will pay sixty-five cents for mining a ton of 2,000 pounds of screened and weighed coal, as it is now screened and weighed at our mines, and for every decrease of twenty-five cents in our card price for nails below $3.25, the price for mining coal shall be decreased two and one-half cents per ton of 2,000 pounds; and for every increase of twenty-five cents in our card price for nails above $3.25, the price for mining coal shall be increased two and one-half cents per ton of 2,000 pounds.

This scale of prices to remain in force for one year from June 1, 1880, and then can be terminated by either party to this agreement giving sixty days' written notice.

BELFONT IRON WORKS CO.

We accept the above proposition.

JOHN GRANT,
ED. EDWARDS,
Committee of Belfont Coal Miners.

VENTILATION.

Systematic perfection in ventilation has not been provided in all, or even in a majority of the mines of the State, although I bear willing testimony to a marked improvement in the all-important matter since the mining law went into operation six years ago. It costs skill, judgment and money to ventilate a mine properly, and these essentials are too frequently wanting.

The mines at Steubenville, which are the deepest shaft openings in the State, are not surpassed in purity of ventilating by any mines in the United States or elsewhere; while in some of the drift mining districts the workings are laid out without art, without science, and with mere brute instinct. In the Steubenville districts the mine superintendents are men of unusual mining intelligence, and have seen good practice from early boyhood, while in other districts of the State men are often placed in charge of mines who cannot tell why air, when heated, flies upward, and who have never seen a ventilating furnace in their lives. Such men ought not, under any circumstances, to be allowed to have control of the ventilating arrangements of mines. Provision should be made by law requiring all mine bosses to pass a satisfactory examination and receive a certificate of competency before assuming charge of mines. Under the method of employing bosses it would require a Mine Inspector to be present at a number of mines every day, and be forever complaining to the courts against such mines. In former reports I invariably called attention to the condition of such mines, and have entered suit against a number of them, from time to time, during my former term as Mine Inspector. Improvement has been made for the time being, but soon the mines were allowed to fall back to the old rude, bad practice.

Quite a number of mines in the State, a majority of which are located in the Hocking Valley region, continue to be operated without any ventilating power, such as a furnace or fan, but rely on the natural forces for the supply of air. Natural ventilation, as is well understood by intelligent, practical men, is of no avail during those seasons of the year when the mine atmosphere and the air outside approach each other in density. No matter what may be the number of openings, the law cannot be complied with under such circumstances. In the interior of such mines the powder-smoke, from blasting the coal, hangs in blinding and suffocating clouds all day. The only motion given to the air is that given by the motion of the cars, and when you ask the miners how they get air, they reply, "we get none except what the mules make." The arrangements for ventilation in all the galleries of the mine, are as faulty as the ventilating powers in use. The entries are usually single, and require to be driven several hundred feet in advance of the fable stream of air, and a cross-heading or aircourse to be cut from one butt-entry to another in forming the aircourse of the mine. There is the plea of economy in ventilating by the natural forces, as by this means the cost of erecting and maintaining a furnace is saved, but the practice of driving aircourses, from one butt-entry to another, has not this merit to commend it, since it cost as much money to cut these aircourses as would suffice for the formation of double entries. This practice was adopted in the early days of mining in the valley, when the art of mine vetilation was not understood, and is persisted in because the parties in charge of the mine at present found it prevailing in the days of their boyhood. In former reports I have pointed out the faulty practice of this system of working mines, and have illustrated with wood-cuts the superior benefits to be had from the double entry system, but some people seem never to learn anything, and never to forget anything.

In the fall of 1877, during my former term of office, while bad air was prevailing in these mines to a very injurious extent, I entered suit against a number of the worst cases. I had no desire to oppress or bear hardly upon the owners of such mines, and gave ample time to all the companies to make or cause to be made, all the necessary improvements required by the statute. Before the cases came up for trial in the court, however, my term of office expired, and the suits were discontinued by my successor in office. Some of the mines against which complaint was then made, have been improved in their ventilating arrangements, while others of them, as also a number of adjacent mines not complained against at the time, though it was my purpose to complain against them, continue to be operated without any artificial means of ventilation. and the entries continue to be pushed hundreds of feet in the fast beyond the reach of a mouthful of fresh air. Unless such and all other mines, in which defective ventilation exists, are improved during the next year, complaint will be made against their owners in the courts. While, as Inspector of Mines. I do not regard it as necessary to notify such offenders that they are violating the law, since they themselves know full well they are doing so, and it is their duty or that of their agents, or responsible superintendents, to know and obey the requirements of the statute in working the mines, I have always done so. Such courtesy on my part has frequently been taken advantage of as license for continued neglect, knowing that the work of the inspector was such that he could not visit a mine more than once in a year.

No district in the State has shown greater improvement in ventilation, since the passage of the mining law, than that of the Mahoning Valley. Eight or ten years ago the mines of this valley were among the worst ventilated in the State or in the United States. The furnaces erected for giving motion to the air were made too small, and were badly constructed; the airways were made too narrow, and the amount of air in circulation in the great majority of the mines was totally inadequate for the healthy abode of the miners. Very frequently the workers under ground were obliged to quit work in the early part of the afternoon, either because their lights would no longer burn, or because they could no longer stand the suffocating atmosphere. This state of the mine atmosphere is yet occasionally met with in some of the mines in this valley.

Owing to the peculiar structure of the basins in which the coal is deposited, it is found impracticable to drive double entries, but with a vigorous circulating current of air traversing the mine, and the timely erection of trap-doors at the mouths of all the rooms opened on the return current, the atmosphere can be made sweet and bracing. Several of the mines have adopted fan ventilation with the most gratifying results. These changes have produced their effects in the happier condition of the miners, and the infrequency of strikes and other labor troubles. Some of the mine owners are disposed to attribute this healthy change in the habits of their workmen to other causes, but this is the true cause. Jules Verne's fanciful picture of Dr. Ox, who by a peculiar process extracted from the atmosphere its due proportion of oxygen, and by this means changed the inhabitants of a peaceful village into fretful and quarrelsome neighbors, life-long friends into bitter enemies, until war ensued, and all the surrounding villagers were regarded as enemies, has been a thousand times illustrated in real life by the effects of the bad air of mines on the habits of miners.

Some of the mines of the Coalton district, in Jackson county, opened up during the past twelve or fourteen months, have not been well laid out, and had not been in operation more than three or four months until the miners were complaining of bad air. Patterson's mines are the best in the district, air-shafts having been sunk and proper ventilating furnaces erected,simultaneous with the opening of the mines. Capital, skill and judgment were all employed in the development of these mines; but all these essentials were sadly lacking in several of the others. Wilson's mine and Morgan's mine, in this district, are well ventilated, though neither of them have good furnaces, and the air will soon become bad, unless proper ventilating power is applied to maintain the aireal current.

The mine of the Milton Furnace and Coal Company, situate at Wellston, has a good furnace and a vigorous current of air in circulation. Two hundred cubic feet of air per man per minute is moved by the furnace and made to traverse the workings. This is the only mine in Jackson county in which the entries are double. Not a dollar of extra expense is added in working the mine by this plan, and its advantages are so apparent that the owners could not be hired to go back to the old method of single-entry working. In the second opening to this mine there is also a good and substantial stairway, for the ingress and egress of the miners.

Complaint was made to me during the summer of the condition of the Huron mine, situate at Jackson. The shaft had been sunk six or seven years ago, and after working a year or two, suspended operation. Mining was resumed in the early part of the present year, and a good deal of time and money was spent in putting the workings in proper shape, a number of falls having occurred in the roof during the time the pit was unused. These falls liberate a gas (carbonic acid), which, mixing with the circulating current, pollutes it to an injurious degree. I feel satisfied the owners will spare neither pains nor money to provide good air.

There are no problems in regard to the proper ventilation of mines which may not be solved by any clear-headed, practical miner, no matter how limited his education may be, if he will only faithfully endeavor to inform himself. In the great majority of the mines of the State there is no fire-damp, that terrible scourge of English coal mines. It is for this reason, however, that the art of mine ventilation is not better understood by so many of the mine bosses in the State, and yet the necessity for approved knowledge on the part of the responsible managers of mines is as great as in the case of non-fiery mines, as in those that give off copiously discharges of fire-damp. Although an explosion of inflammable gas destroys its victims in the most sudden and appalling manner, in the mines where black damp is allowed to load the air the men's health is slowly, but nevertheless surely undermined; or, as one of the English Mine Inspectors puts it, the men are killed by inches. Roomy air-courses, well-constructed furnaces, or, better still for our shallow mines, good ventilating fans, will move an abundant column of air. Double-entries under ground, the proper and timely opening of break-troughs to send the current well up to the working-faces of the miners, promptly closing and rendering air-tight all unused air-holes, will keep the working-faces sweet and wholesome.

FIRE-DAMP AND WATER.

Our mines are comparatively free from the presence of that dread destroyer of human life—fire-damp. Only in the Steubenville district is this gas ever met in any alarming quantity, and so perfect is the discipline of the mines, so careful are the managers in examining, or causing to be examined all the working places every morning with the safety-lamp before any of the workmen are allowed to enter the mines, and so admirable are the arrangements for creating and distributing an abundance of fresh air through all the ramifications of the mine, that so long as these conditions are maintained, explosion is impossible.

In the coal mines of England and Wales, 472 lives were lost during the present year by fire-damp explosion, as the following statement shows:

	Lives lost.
January 21. Leycett Colliery, North Stafford	62
February —. Allerton Bywater Colliery, near Leeds	2
March 10. Bedwelty Pit, Swansea, South Wales	4
April 5. Bell Isle Pit, near Leeds	4
May 19. Kiveton Park Colliery, near Sheffield	4
June 3. Aston Manor Colliery, near Sheffield	1
June 8. Carroch Pit, Swansea	3
July 15. Risca Colliery, South Wales	120
August 2. Berham Colliery, Wrexham	8
August 16. Redbourne Pits, near Frome	2
September 8. Seaham Colliery, Durham	161
*December 10. Penygraig Colliery, South Wales	101
Total	472

*Added after this report was filed.

The only other districts in Ohio, where fire-damp is ever seen, is in some of the Mahoning Valley mines; in one or two of the mines opened on the Niles and New Lisbon Railroad, and in one of the mines of Jackson county. The fire-damp in these districts is not given off in any alarming quantity; still where this gas is once seen in a mine, nothing should be left afterwards to miscalculation, or to accident. There is but one way to insure safety against explosion, namely: to circulate plenty of fresh air throughout every room and gallery, and to carefully examine every working place with a safety-lamp every morning before any of the miners are allowed to enter the mine. If gas is met in a mine, it is due to but one cause—insufficient ventilation, and it should be removed before any of the workmen go into the pit. If explosion occurs it can admit of no possible excuse, unless ignorance and carelessness can be considered an excuse. Since the mining law went into operation, April 6, 1874, there has not been a single death from this cause in Ohio, and only in one or two instances have miners been seriously burned by an ignition of the fire-damp.

In December, 1879, the workings of the Tropic shaft, in Jackson county, were inundated by water, caused by the roof of the mine falling to the surface. The water was pumped out, and work resumed in the mine as soon as practicable, and the fallen area was filled up with clay and furnace cinder. During the summer of the present year the roof again gave way in a room which had been driven below Salt Creek; the first inundation was slow in operation, affording ample time for the safe withdrawal of the underground workmen; the latter occurred during the night when there was no one in the pit; it must have been sudden and immediate, for the break occurred directly under Salt Creek. The course of the creek was now changed, the chasm filled with hay, clay, furnace cinder, etc., and the miners of the mine again pumped the workings dry. In resuming work the miners were forbidden from entering the mine, when the creek was high, and were ordered to quit work and come out as soon as the creek began to rise. As several of the rooms are driven under Salt Creek, the danger of one or more of them falling in directly under the creek is as great now as when the workings were submerged during the summer from this cause.

This shaft, which is but 28 feet deep, is sunk in a flat a few hundred feet from the present bed of Salt Creek. The shale covering the coal is soft and brittle, and cannot well be kept up over a large part of the mine. Every precaution is taken to prevent accident, by the owners of the mine, but no amount of precaution can insure safety, and an accident is liable to occur at any hour. There is but one way to insure absolute safety, and that is to abandon the mine altogether and forever.

This mine is one of the first where serious danger of drowning the whole underground force has presented itself since shaft mining was commenced in Ohio, but it will be, by no means, the only case which will present itself in future operations. Several of the mine workings in the Steubenville district were very unwisely pushed under the Ohio river, ten or twelve years ago. The workmen have told me that at the time their rooms were driven under the river they could hear the paddle-wheels of the steamboats above them. Some day there will be danger of submergence by reason of such excavation.

The "Clark mine," situate near Massillon, in the Tuscarawas valley, is another mine which became inundated by water. When this occurred the pit was idle, and hence no danger of loss of life was feared. The owners of this mine contemplate pumping out the water during the coming winter, with the object of resuming operations under ground. Unless unusual care is taken to guard against submergence, the mine will fill up again as soon as the water rises to the usual flood height.

Our coal mines are just beginning to become seriously dangerous, and if accident is to be prevented—accident which will alarm the State and throw hundreds of families into mourning—the mining law must be made more stringent than it now is. No attention should be paid to the mining operators whose constant cry is, "Our mines are comparatively safe—they are not deep enough to be dangerous," and who, when an alarming accident occurs, regard it as purely accidental, or as due to the rashness of miners.

MINERS' UNIONS.

The miners of the State do not improve their opportunities for the amelioration of their condition in life. There are miners in every district of the State of philanthropic views, fine intelligence, and sound judgment, who, with properly directed effort, might become real benefactors of their fellows, and leave the world better than they found it. All their energies seem directed to organization for maintaining the price of mining at the highest point the coal markets will afford the operators to pay. This is all right and proper, in itself, but is by no means the sole duty of life. The establishment of night-schools, of libraries and reading-rooms, of Sunday-schools and churches, open a wide field of usefulness. In those districts of the State, and of every State, where there are intelligence and sobriety; where there are reading-rooms and libraries, and where saloons are few and far between, there are greater contentment, better wages paid, and fewer strikes, than where ignorance and saloons prevail.

The miners of Germany have superb organizations, which deserve to be studied by the miners of Ohio, and other States. These unions have brought contentment to the German miner, and might be adopted by the miners of the United States with advantage, and in their formation the operators of the mines ought to lend a helping hand.

The miners' unions of Germany are the oldest associations of the kind in the world, having originated in the silver mines of the Hartz mountains more than six hundred years ago, and they now extend over every mining country of continental Europe, receiving corporate rights from government. The system has been perfected in Prussia, and is simply admirable. Every miner, a member of the union, is required by law to contribute 3½ per cent. of his earnings, and the owner or orperator 1 per cent. of the yield of the mine into the benefit fund of the association, and the money thus collected is applied in payment to members during periods of sickness or disability resulting from accident in the mines.

The members of the union are divided into two classes—permanent members and temporary members. Temporary members only possess personal rights, while permanent members, who become such after having belonged to the union for five years, have their rights in the association extended to all their family. Members forfeit their rights to any benefit fund, and in fact cease to be longer members, when they refuse to pay their regular monthly contribution. All the funds of the union are under the control of the inspector of mines, who is responsible for all defalcations, and who is also obliged by law to see that all members are fairly treated. Any miner who belongs to the union, who may be hurt in the mines in the pursuit of his calling, or who may become sick and unable to work from any natural cause, draws pay from the funds of the association during the whole time he is off work, and he also receives medical assistance free of charge. Should accident or disease prevent a member from working in the mines, or when a member is no longer able to work, through old age, he draws a life pension in consequence, and after his death his widow receives a monthly pension till she marries again, and all his children draw pensions until each arrives at the age of fourteen years. When a member is killed in the mines, or dies from any cause, the association pays all funeral expenses. There is no compulsion exercised to get members to join; the union is simply and only a benevolent association like the Free Masons or Odd Fellows, except that there is no secrecy about its operations. It partakes in no sense of a trades union organization, associations of this character being contrary to law until the year 1869, when the ban was removed forever.

The result of such legislation has made the miner of Germany proud of his occupation. "He is as proud as a miner" is a common proverb. Very few German miners ever emigrate to this country, being secured by their superb organization against want in their old age. Thousands of Germans work in the coal mines of the United States; but question them and you will find that they, with rare exceptions, never saw a coal mine in fatherland.

Were organizations of a character similar to these established in the mining regions of the State, and facilities provided for the education of the boys and young men of the mines, strikes would soon become as scarce as they are now common; and instead of the Sheriff of the county being required to call upon the Governor of the State every few months for aid to quell some threatened disturbance against persons and property, the miners, through the vast influence which their intelligence and numbers would give them, would be sending representatives to the State Legislature to make laws which we are all, Sheriff and Governor included, bound to obey. The proper adjustment of the relations of labor and capital can only come through increased intelligence, sobriety, firm union and moderation on the part of employes. The workingman, if left to his own resources, will not, as a general rule, seek to improve his condition in this country, for the tendency in all countries where wage-laborers are paid good wages is to produce thoughtlessness as to the future. The labor question, to which little or no attention is paid by our philanthropists and statesmen, is one of the gravest questions of the future. The growth of intelligence among our workingmen must keep pace with the increased demands of individual restraint. Reason, not bayonets, are demanded by our age and nation. Workingmen must govern themselves and respect the laws and rights of others. Only in this way can civil liberty continue.

As illustrating the influence upon the habits of miners in the maintainance of reading-rooms and libraries in their midst, I need only refer to the condition of the miners in Washingtonville, in Columbiana county. Twelve years ago the Cherry Valley Iron and Coke Company joined their workmen in the erection of a mining institute. Since that time a mule-driver and a coal-digger have studied law, been admitted to the bar, and are building up a lucrative practice; another coal-digger has graduated at the Cleveland medical college, and is rapidly acquiring practice in his new profession, while a number of others are school teachers, all of whom owed the inspiration of bettering their condition in life to their educational surroundings. The miners of this place are among the most sober, intelligent and industrious citizens to be found in any calling. There are few strikes there, because reason is used in the adjustment of wages disputes. The mines are well ventilated, and the miners and operators regard each other as common friends, mutually dependent upon each other. This state of affairs ought to exist everywhere. There should be no strikes or lock-outs. Strikes are contrary to the genius and spirit of American institutions. They belong to the old world, and should be frowned down in a free country.

Another mine in this State, in which the mutual relations of the laborer and capitalist are properly understood, is that of the Milton Furnace and Coal Company, in Jackson county. Whenever any dispute arises at this mine, it is settled by reason, and never by a strike. The General Manager of the company meets with any committee that may be appointed to confer with him on any grievance, however trifling it may be. The matters in dispute, great or small, are talked over and are always settled amicably. This company tries to provide the miners with steady employment; will not employ more hands than are needed to supply the demand for coal, and the miners endeavor to supply the demand by regular attendance at the mine. At the Coalton mines, only four miles distant, two strikes have already occurred since the mines were opened, less than two years ago, and in one case the military were called out, while at the Milton mine, which has been running for seven years, no dispute has ever arisen which has not been adjusted in half an hour, and not a single day's work has been lost as a result.

CERTIFICATED ENGLISH MANAGERS.

Since the year 1872 all underground managers of mines are required, by the English mining law, to appear before a board of examiners and receive a certificate of competency, previous to assuming charge of mines.

The following qualifications are required on the part of applicants presenting themselves for examination, viz.:

Applicants must be above 21 years of age, and must have had either—

1. Two years' experience, underground, in any capacity; or,
2. Have served three years in a mining engineer's office, and have been engaged in the active survey of pits and making plans; or,
3. Have been employed as a mechanic at a mining establishment for two years, and have been, during the eight months immediately preceding their application, employed under ground acquiring a knowledge of mineral workings.

The subjects of examination are the following, viz.:

Written examination, applicants requring to count on:

1.	Mines Regulation Act, 1872, general knowledge of	20
2.	Ventilation, theory and practice	80
3.	Sinking, fitting and pumping	40
4.	Winding and haulage	40
5.	Modes of working coal, iron, stone, or other mineral, having reference to the nature of roofs and pavements, and setting of the workings of a new pit	80
6.	Surveying and drawing	60
7.	Arithmetic up to vulgar fractions, including calculation of areas and velocities	40
	Maximum number of marks	360

There need not be *viva voce* examinations; 120 marks to pass, but every candidate must obtain at least 30 marks in each of No. 2 and No. 5, and must obtain at least 60 marks out of at least two of the other subjects.

Candidates for examination for a certificate of competency, are required to sign an undertaking to keep the information contained in the examination papers strictly private and confidential; and, also, to engage not to take a copy of any portion of such paper, or to publish the same in any way.

The following are some of the questions, selected at random, which have been prepared by examining boards:

Explain the ordinary conditions for adopting the long-wall and pillar and room working.

Draw a free-hand sketch, or describe the mode you would adopt in laying out the workings of a colliery from the pit-bottom, giving the dimensions and showing ventilation by arrows.

Explain the difference between pillar and room and long-wall workings, more especially as relates to their ventilation, timbering and production of coal.

What is ventilation, and why is it required in mines?

Describe the method of measuring the air of mines by means of powder smoke and by an anemoneter.

What is the cause of friction of air in mines?

How does friction increase or decrease?

How does splitting the air affect the quantity passing through a mine?

What is the meaning of the pressure of the air?

How does the pressure of the atmosphere affect the velocity of the mine currents?

State the rule for finding the weight of a column of air.

What is fire-damp, and what are its component parts?

What other gases besides fire-damp are met in coal mines? Give an account of the nature and properties of the various gases of coal mines.

Explain the principles of a safety-lamp.

Explain the uses of the barometer and thermometer in mines.

What is a water-gauge, and for what purpose is it used in mines?

Describe the best method of timbering, walling and tubing a shaft.

Describe the best method of sinking the quicksand.

Explain the action of a syphon, and its use and application in draining mines.

State the various methods of pumping water out of mines.

Write a short essay on the daily operations of a colliery in full operation.

Atkinson's "Gases of Coal Mines" and "Friction of Air in Mines" are among the best works on the subject of mine ventilation.

I have taken the liberty to quote at length from the "Gases of Mines" the whole of the following article, being from the pen of this gifted authority on mining:

THE GASES OF COAL MINES.

By John J. Atkinson.

A variety of gases is given off by the coal and other minerals met with in coal mines; a further supply of gases arises from the breathing of men and animals, and from the burning of candles and lamps, as well as from the explosion of the powder used for blasting the coal and stone in the mines. The whole of these gases are capable of causing the death of men and animals breathing them in their pure and undiluted state, and some of them require to be mixed with many times their own volume of air before the mixture they form with it can be breathed, for any great length of time, with safety.

Some of the gases given off in coal mines, when mixed with certain proportions of air, form violently explosive mixtures. Such a mixture of air and gas, on being ignited by a naked candle or other flame, suddenly explodes and becomes one mass of living flame, scorching and burning everything that may happen to be in contact with it. Such an explosion, in general, also creates a complete hurricane, or tornado, of immense force and violence, tearing and driving all before it—knocking down the masonry erected for the guidance of the ventilation, as well as the props and timber erected to support the roof of the mine, which falls in great masses, causing bodily injury or death to those it may fall upon, and often enclosing and imprisoning those who, being unhurt by its fall, are left stunned by the concussion, more or less scorched by the flames, and, without lights, shut up to breathe the deleterious atmosphere produced by the explosion. The flames of such an explosion being extinguished, and its violence exhausted, there remains an atmosphere so hot, and so charged with noxious gases and steam, as to cause the death of all who are left alive to inhale or breathe it. This resulting atmosphere is generally termed *after-damp.*

The grand object of the ventilation of mines is to cause such a current of air constantly to circulate through them as shall, by mixing with and diluting the gases, render them harmless, and, in that state, carry them off as quickly as they are produced in the mines. It is here proposed, in the first instance, to remark upon the chemical composition of the air we breathe; then upon that of a few of the most important gases met with in coal mines, and afterwards to notice some of the leading principles of ventilation, by taking advantage of which we get rid of the gases as fast as they are given off in mines.

ATMOSPHERIC AIR.

Air is, almost entirely, a mixture of two gases, oxygen and nitrogen; carbonic acid is also present in limited but variable proportions, forming, on an average, about 1 part to 2,500 parts of our atmosphere. Besides *oxygen*, *nitrogen*, and a trace of *carbonic acid gas* in the atmosphere, there is always more or less of watery vapor diffused through the gases of which it is composed; but this vapor is variable in amount, is not considered as forming a constituent part of the atmosphere, and is, therefore, not embraced in statements as to the chemical composition of air; yet its effects are of the highest importance, both in the general economy of nature, and also in considerations relative to the ventilation of mines. Dry air is chemically composed of

	By Weight.	By Volume.
Nitrogen gas	77 per cent.	79 per cent.
Oxygen gas	23 "	21 "
	100 "	100 "

A cubic foot of air at the temperature of melting ice (82°), and under pressure of 14.7 lbs. per square inch, or 2,116.8 lbs. per square foot, weighs 0.080728 lbs.; so that under the same conditions 1,000 cubic feet weigh 80.728 lbs. avoirdupois.

NITROGEN GAS.

Nitrogen gas is rather lighter than air taken in equal volumes, at the same temperature, and under the same pressure. The specific gravity of air being taken as 1,000, that of nitrogen gas is only 971.37, so that the weight of 1,000 cubic feet of air being 80.728 lbs., that of 1.000 cubic feet of nitrogen is only 78.416 lbs. at the temperature (32°) of melting ice, and under the pressure of the atmosphere, taken at 14.7 lbs. per square inch, or 2,116.8 lbs. per square foot. A cubic foot of nitrogen, under the same conditions of temperature and pressure, weighs 0.0784.167 lbs., and a cubic foot of air 0.080728 lbs., as heretofore stated.

Nitrogen gas has neither color, taste, nor smell, and so far it is like air itself. It will not support life, but causes death when breathed. It will not support combustion, but extinguishes lights. This gas has very little chemical affinity or attraction for other bodies; its chemical properties are rather those of indifference than of activity; its position amongst gases, in general, being almost like that of water amongst liquids, as it serves to render their properties less active. It dilutes the oxygen of the atmosphere, which could not long be breathed without being diluted with nitrogen. Nitrogen is, however, probably the best part of manures for land; and it is a component part of nitrous oxide or laughing gas, of ammonia, and of nitric acid, or aquafortis, as well as of many other compounds.

OXYGEN GAS.

Oxygen gas, as has been stated, forms about 21 parts by volume, or 23 parts by weight out of every 100 parts of air, being rather more than one-fifth part. The specific gravity of air being taken as 1,000, that of oxygen gas is 1,105.63; 1,000 cubic feet of air, at 32°, and under a pressure of 14.7 lbs. per square inch, weigh 80,728 lbs.; 1,000 cubic feet of oxygen gas, under the same conditions, weigh 89.255 lbs.; so that this gas is rather heavier than an equal volume of air. Oxygen gas has neither color, taste, nor smell. This gas, in a free and uncombined state, is essential to life; we must breathe it in this state or die; in its undiluted state, it is not fit to breathe beyond a very short time. In our atmosphere it is fitted to sustain life by dilution or mixture with nitrogen gas. Chemical compounds in the gaseous form may contain large proportions of oxygen and yet be unfit for respiration or breathing; to be suited for this purpose, the oxygen must be free and uncombined, and at the same time diluted.

Oxygen is the most abundant substance in nature, and constitutes at least one-third of the solid mass of the earth—23 per cent. of air, and 89 per cent. of water.

Oxygen has strong affinities, and combines with all known substances, except *fluorine.* It forms, with other substances, no less than 136 inorganic compounds, and it would be difficult to say how many organic ones. This gas is the great supporter of combustion. Substances that burn in air burn much more vividly in pure oxygen, showing that the oxygen in the air is the supporter of combustion. Irón wire will burn in oxygen, but not in air; and this is also the case with other metals in a finely divided state. When, by breathing, we inhale air into our lungs, a part of the oxygen it contains combines with carbon, and we exhale or breathe out, as the result, an equal quantity, by volume, of carbonic acid gas, and consequently liberate about 3¾ times as great a volume of free nitrogen gas.

Having glanced at the chemical constitution of the atmosphere, let us next consider that of the principal gases met with in coal mining.

CARBONIC ACID GAS.

When this gas is met with in coal mines it is often called *stythe, choke-damp, or black-damp.* It is composed of oxygen and carbon. We have already considered the nature of oxygen as a component part of the atmosphere, but we must not expect to find it show the same properties when chemically combined either with carbon or any other substance whatever. Carbon, the other part of choke-damp, forms the chief ingredient in coal; and coke contains a still larger proportion of this substance; but the diamond is pure carbon, in a crystiline state. The chemical composition of carbonic acid gas is—

By Atoms.		By Weight.		By Volnme.
Oxygen	2	72.73	per cent	1
Carbon	1	27.27	“	1*
	1	100.00	“	1 condensed.

Now, although this gas contains nearly 3 parts out of 4, by weight, of oxygen (the life-supporting element), yet, because it is combined with another substance (carbon), the result is, in this case, a poisonous gas. It is dangerous to life to breathe air containing 8 per cent., or one-twelfth of this gas. Lights are extinguished in air containing 10 per cent., or one-tenth of it. At 32°, under a pressure of 14.7 lbs. per square inch, 1,000 cubic feet of air weigh 80.728 lbs., and 1,000 cubic feet of carbonic acid gas weigh 123.353 lbs., so that it is rather more than 1½ times as heavy as an equal volume of air. The specific gravity of air being 1,000, that of carbonic acid gas is 1,528.01. Before being mixed with air it rests next to the "thill," or floor, of mines, owing to its great heaviness or density when compared with air. This gas, besides being given off naturally into many mines, is always found to result from the breathing of men and animals, the burning of candles and lamps, and mixed with other gases, from the explosion of the powder used in blasting. Near the mouth of an adit or drift, at Butterknowle colliery, in the county of Durham, the writer has seen several small birds lying dead from the effects of this gas. They had come to feed upon crumbs, where the workmen ate their meals, close to the mouth of this, an abandoned drift, and the gas coming out of the drift at the level of the ground had overcome them. At the same colliery, in several places where the coal has been worked away, the ground has been rent up to the surface, and it is said that birds flying across these rents or pitfalls, in some instances, are so quickly affected by the escaping gas as to drop into the holes and die there. Without disputing the fact of dead birds being found in the holes, the reason assigned as the cause of their coming there appears to be rather doubtful. The effect of the gas is not, perhaps, so instantaneous as to account for it. Unfortunately, birds are not the only sufferers from this gas, for many human beings have met their deaths through breathing it; and in many other cases injurious effects are produced on the health of workmen through the mixture of this gas, in small proportions, with the air of mines.

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*Bunsen assumes that the hypothetical volume of carbon at one-half of that assumed here; but as he gives its density at double the value here given to it, the results are not altered.

Limestone consists of carbonic acid and lime, and chalk is of a similar composition; these ingredients, however, being generally mixed with oxide of iron, magnesia, and other substances in less but variable proportions.

PHOTO-CARBURETTED HYDROGEN GAS,

LIGHT CARBURETTED HYDROGEN GAS, OR, AS IT IS SOMETIMES CALLED, MARSH GAS.

This gas is the fire-damp of mines. It contains one atom of carbon combined with two atoms of hydrogen, or some multiple of these. Taking the atomic volumes of carbon and hydrogen to be the same, it contains one volume of carbon combined with two volumes of hydrogen—in all three volumes—but the three volumes are condensed into one volume of fire-damp. The weight of air at the temperature of melting ice (32°) and 14.7 lbs. per square inch pressure, is, for 1,000 cubic feet, 80.728 lbs.; that of 1,000 cubic feet of gas, under the same conditions, is 45.368 lbs., so that the specific gravity of this gas is 562[*], that of air being 1,000, it being rather more than half as heavy as an equal volume of air under the same conditions. Owing to the fire-damp of mines being lighter than air, it lodges next the top or roof in mines, until, by diffusion, it gets quite mixed with the air. This gas would soon cause death if breathed in a pure and undiluted state; but, when mixed with twice its own volume of air, it may be breathed for some time without serious effects. It quickly extinguishes lamps or candles when unmixed with air. Fire-damp, or light carburetted hydrogen, contains nearly 25 per cent., by weight, of hydrogen. Hydrogen is the lightest known gas, being only one-fourteenth part of the weight of air. The hydrogen in fire-damp is, however, condensed into a smaller volume than it occupies in a free state. Light carburetted hydrogen gas is chemically composed of—

	By atoms.	By weight.	By volume.
Hydrogen	2	24.6 per cent	2
Carbon	1	75.4 "	1
	1	100 "	1 condensed.

In the fire-damp of mines, however, we find a small proportion of other gases mixed with it. When 1 part of fire-damp is mixed with 30 parts of air, by volume, its presence can be detected by the appearance of the flame of a candle; and as the quantity of fire-damp is gradually increased from 1 up to 2 parts in 30 of the air, the appearance of the flame is more and more affected by it; but even in the latter proportion the mixture will not explode. The flame of the candle is surmounted by a pale blue halo, called in mining language a "top," or "cap," which partakes more or less of a brown color, according to the quantity of *stythe*, or carbonic acid gas, that may be present along with the fire-damp. The examination of the flame, for the purpose of forming a judgment as to the quantity of fire-damp mixed with the air, in mines, is, in mining dialect, called "*trying the candle*," or "*trying the lamp.*" When the fire-damp forms as much as 1 part out of 13 of the air, the mixture becomes explosive, so that, if ignited by an exposed flame, the whole of the mixture is converted into a mass of flame; in this state of the mixture, however, the force of the explosion is comparatively feeble. When there is only 9 to 10 times as much air as fire-damp, the explosive force is greatest. If the proportion of gas be greater than 1 part out of 9 to 10 of air, by volume, the force of explosion gradually becomes less and less, until there is only five times[*] as much air as gas, when the mixture will no longer explode, but, on the contrary, will extinguish the flames of candles or lamps that may be brought into it.

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[*] Professor Bunsen gives the specific gravity of marsh gas at .55314, that of air being 1.

The presence of carbonic acid gas, or of free nitrogen gas, in mixtures of fire-damp and air, is found to lessen their explosive force; so that if we add to the most explosive mixture one-seventh part of its volume of carbonic acid gas, it will not explode at all. Air containing one-fourth part of fire-damp, by volume, may be breathed for some time without very serious effects being produced on the animal frame. Common coal gas, as used for lighting, contains a large proportion of light carburetted hydrogen gas—the fire-damp of mines. Besides this, however, it contains a considerable proportion of pure hydrogen, some carbonic oxide, and olefiant gas.

When a mixture of air and fire-damp is exploded, the chemical changes that take place, and the nature of the resulting mixture, or after-damp, are as follows:

MIXTURE BEFORE EXPLOSION.

		By Atoms.				*By Measure.*		
		No. of Atoms.		Relative volume per Atom.		Uncombined Volume.	Combined Volume.	Volume per cent.
Air	Oxygen	4	x	1	=	4	18.8	90.385
	Nitrogen	7.4	x	2	=	14.8		
Fire-damp	Carbon	1	x	2	=	2	2	9.615
	Hydrogen	2	x	2	=	4		
						24.8	20.8	100.000

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[*] "Even when mixed with three, or nearly four times its bulk of air it burnt quietly in the atmosphere, and extinguished a taper." "When mixed with between 5 and 6 times its volume of air it exploded feebly." "It exploded with most energy when mixed with 7 or 8 times its volume of air, and mixtures of fire-damp, and air retained their explosive power when the proportions were 1 of gas to 14 of air. 1 of carbonic acid added to 7, or 1 of nitrogen added to 6 parts of explosive mixture rendered them inexplosive."—*From the Collected Works of Sir H. Davey, page* 10, *Vol. VI.*, 1840.

MIXTURE AFTER EXPLOSION.

		By Atoms.				By Measure.		
		No. of Atoms.		Relative volume per Atom.		Uncombined volume.	Combined volume.	Volume per cent.
Free Nitrogen		7.4	x	2	=	14.8	14.8	71.2
Carbonic Acid Gas	Carbon	1	x	2	=	2	2	9.6
	Oxygen	2	x	1	=	2		
Steam	Hydrogen	2	x	2	=	4	4	19.2
	Oxygen	2	x	1	=	2		
						24.8	20.8	100.8

Before explosion, there may happen to be present either an excess of air or of fire-damp, beyond what is necessary to cause the explosion; and if so, they will remain mixed with the after-damp, in an unchanged state, after the explosion has taken place. There never can, however, be such an excess of air present as to render the after-damp fit to breathe, or the explosion could not take place; the limits are such that this is impossible. The above proportions of 1 of fire-damp to 9.4 of air form the most explosive mixture, all other proportions forming less explosive mixtures.

From the second table, we perceive that the after-damp contains between seven and eight times as much free nitrogen as carbonic acid gas, or choke-damp. It was at one time, a popular mistake to suppose that the injurious part of the after-damp consisted only of carbonic acid gas, or choke-damp—not amongst scientific chemists, but amongst respectable mining authorities—and that, not very long ago. After-damp, it may be seen, by the second table, contains about 71 parts of free nitrogen, 9½ parts of carbonic acid gas, and, at the moment of explosion, 19 parts of steam; so that it may be said, at this stage, that after-damp contains, in round numbers, seven parts of nitrogen, one part of carbonic acid gas, and two parts of steam, out of a total of 10 parts. Directly after the explosion, a large part of the steam condenses, and leaves, as a residum, about 7½ parts of nitrogen, and one part of carbonic acid gas, out of eight and one-half parts; the whole unfit to breathe, and incapable of supporting either life or combustion. A small excess of air, or of fire-damp, might be left mixed with the after-damp of an explosion, beyond what is noticed in the tables as being chemically changed; but in no case could the air of the after-damp contain less than twice its own volume of deleterious gases, or the explosion could not have taken place; such a mixture, if breathed, would soon cause death. Since explosions can not always be prevented, how important it is, then, to be prepared to mix and dilute the after-damp with fresh air, in as speedy a manner as possible, after their occurrence. If there is more fire-damp present than is chemically changed by an explosion, the force of the explosion itself is lessened, but the after-damp resulting is more deadly than if an excess of air had been present at the time of explosion.

CARBONIC OXIDE.

This gas is sometimes called white-damp, when met with in the mines. Assuming, as before, that the atomic volume of carbon is twice as great as that of oxygen, its composition is as follows:

	By Atoms.	By Weight.	By Volume.
Oxygen	1	56.69	½
Carbon	1	43.31	1
	1	100	1 condensed.

Its specific gravity is 975.195, that of air being assumed at 1,000; so that 1,000 cubic feet of air at 32°, and under a pressure of 14.7 lbs. per square inch, weighing 80.728 lbs., an equal volume of this gas under the same conditions will weigh 79.426 lbs., and one cubic foot under the same conditions will, therefore, have a weight of .079426 lbs.

Carbonic oxide has a much more deleterious effect on the animal economy than carbonic acid; air which contains only one per cent. of carbonic oxide almost immediately causes the death of warm-blooded animals, as has been shown by the decisive experiments of M. Felix Leblanc. Carbonic oxide is itself an inflammable gas, but does not support the combustion of other bodies. It has no taste, but has a peculiar odor. Small animals immersed in it die instantly. When inhaled, it produces giddiness and fainting fits, even when mixed with a fourth of its bulk of air. It is easily kindled, and burns with a blue flame, being transformed into carbonic acid by the process. The carbonic acid formed by combustion at the bottom of a coal, coke, or charcoal fire is sometimes converted into carbonic oxide, by being deprived of a part of its oxygen, as it passes upwards through the red-hot embers; and, on coming into contact with the air, at the top of the fire, burns there with a blue flame, and is again converted into carbonic acid gas. This gas is, perhaps, never found in coal mines except as the result of the explosion of gunpowder, or the combustion of coal or wood. Carbonic oxide is obtainable in a state of purity by heating yellow ferro-cyanide of potassium with eight or ten times its weight of oil of vitriol. Bunsen obtained it by slightly heating a mixture of formic and sulphuric acids; and to ensure the perfect purity of the gas, he passed it through a concentrated solution of caustic potash. Such a proportion of this gas might be mixed with air as to form a mixture in which candles or lamps would burn, while life would become extinct: and it is probable that many deaths in mines have resulted from this gas, in situations where the lights have continued to burn.

It appears to be very probable that the deaths of the men and boys in the late accident at Hartley Colliery arose in a great measure from this gas given off by the furnace, after the stoppage of the air-current by the closing of the shaft: inasmuch as the lights used by the workmen engaged in clearing the shaft appeared to be rather increased in brilliancy than otherwise at the time when the worst effects were felt from the escaping gas; and the mine gave off no fire-damp and very little choke-damp.

At page 120, in the minutes of evidence taken before a Select Committee of the House of Commons, on accidents in mines, in 1835, the late George Stephenson, in reply to question 1,853, gives an account of an accident at Newbottle Colliery, by which several persons lost their lives by a gas in which the lights burnt well, and which the witness supposed to have been sulphuretted hydrogen gas; but it appears to be more probable that it was a mixture of carbonic oxide, sulphurous acid, and a small quantity of carbonic acid gases, generated by the explosion of gunpowder in the drift, where it was found to prevail; because sulphuretted hydrogen gas has a particularly offensive smell, of which no mention is made in the account of the accident.

The writer is acquainted with several instances where gases have caused deaths, and with others where they have caused severe indisposition, in places where candles continued to burn brightly; in some of these cases, the gases were apparently produced by the explosion of gunpowder, and in others, by the combustion of coals; and hence it appears to be probable that carbonic oxide was a prominent ingredient in them. In an experiment by M. Leblanc, a large-sized dog was asphyxiated in an atmosphere which contained 4 per cent. of carbonic acid, and only ½ per cent. of carbonic oxide.

HYDRO-SULPHURIC ACID, OR SULPHURETTED HYDROGEN.

This gas is sometimes met with in coal mines. It is colorless, but distinguishable by its unpleasant smell, which resembles that of rotten eggs. It produces fainting fits and asphyxia, if inhaled, even when present only in very small proportions with atmospheric air. When inhaled, in its pure state, it acts as a powerful narcotic poison. It does not support combustion, but is itself inflammable, and burns when exposed to a supply of air and ignited; and, when mixed with oxygen gas, the mixture is explosive. It reddens tincture of litmus, but the reddening disappears on exposure to the air.

The composition of sulphuretted hydrogen is as follows:

	By Atoms.	By Weight.	By Volume.
Sulphur	1	94.15	1-6th
Hydrogen	1	5.85	1
	1	100	1

According to Bunsen the specific gravity of this gas is 1,174.88; that of air being assumed at 1,000, under the same conditions as to temperature and pressure. Sulphur heated strongly and repeatedly sublimed in fire-damp freed from oxygen by phosphorus, produced a considerable enlargement of its volume, sulphuretted hydrogen was formed, and charcoal precipitated; the volume of sulphuretted hydrogen produced (ascertained by absorbing it by solution of potassa) was exactly double that of the fire-damp decomposed.

Sulphuretted hydrogen gas may be inflamed by charcoal or iron, even at a low red heat. In air it burns with a blue flame, forming water and sulphurous acid, and depositing sulphur. According to some authorities, 1-1500th part of this gas in air is instantly fatal to small birds, 1-1000th killed a middle-sized dog, and a horse died in an atmosphere that contained 1-250th part of its volume. The presence of sulphuretted hydrogen gas in the atmosphere, even in small proportions, can be detected by its action upon moist carbonate of lead, spread upon white paper, which it blackens. M. Parent Duchatelet observed that workmen breathed with impunity in an atmosphere containing 1 per cent. of sulphuretted hydrogen, and he states that he himself respired air containing as much as 3 per cent. of the gas, without experiencing any serious results. This gas is formed whenever sulphur in a very comminuted form is brought into contact with hydrogen in the act of being given off, and is probably formed, to some extent, where pyrites is undergoing decomposition in mines. When this gas is present with the air, in mines, candles will burn in the mixture, so that, if it is not detected by its odor, it may prove fatal to life before its presence is detected.

It appears to be probable that this gas is frequently formed in old unventilated workings partly filled with water. There are two instances mentioned by Mr. Nicholas Wood, in his evidence before the Committee of the House of Commons on accidents in mines, in 1853—one at Hartley Colliery, which proved fatal to one person, and another at Tyne Main Colliery, where ill effects were felt, notwithstanding that the lights burnt well; both of which, in all likelihood, were due to the generation of this gas from the action of the water upon pyrites in old workings.

A man breathes into his lungs about one-fifth of a cubic foot of air per minute, and converts about seven per cent. (by volume) of this into carbonic acid gas, which, with about three and three-quarter times as much free nitrogen, he exhales, along with about 66⅔ per cent. of the air he breathes, in an unchanged state. The largest lamp used in mining converts less oxygen into carbonic acid gas than a workman. Both give off water vapor as well as carbonic acid gas. When coal is on fire, it gives off, in burning, carbonic acid, carbonic oxide, and sulphurous acid gases. The explosion of gun-powder gives rise to carbonic acid, nitrogen, carbonic oxide, and steam, besides carburetted and sulphuretted hydrogen in small proportions. In the ordinary course of mining, these causes give rise to so small a quantity of gas, in proportion to the air, that they hardly belong to the subject in hand, unless in reference to the state of a confined and unventilated part of a mine, where a shot has been fired, or in the more rare case, of coal being on fire in a mine.

Sir Humphrey Davy discovered that the flame of ignited gas would not pass through fine wire gauze, containing 28 holes for each inch in length, or 784 holes per square inch, unless the gas is moved with great velocity against the gauze, or the gauze against the gas; and by enclosing the flame of an oil lamp in a cage made of this gauze, we are able to carry a light into an explosive mixture of air and gas without setting the gas on fire on the outside of the gauze; by this means an explosion is avoided. If we find ourselves with a safety-lamp in an explosive atmosphere, we should only try to put out the flame by carefully drawing down the wick, and by no means try to blow it out, or we might blow the flame through the gauze and cause an explosion. An explosion might result from drawing the flame of the lamp through the gauze by means of a tobacco pipe; yet workmen are not unfrequently detected in this very daring and dangerous practice in mines. Outside-feeding, or oil-tubes, used to be attached to safety-lamps, but these are dangerous, as the flame might pass down the wick tube, and up the oil tube, and so fire the gas on the outside of the lamp, if the oil-plug was out or fitted badly, and the wick was small compared with the tube; but feeding tubes are not used now, at least in many districts. There are several sorts of safety-lamps now more or less used, which give more light than the Davy lamp; glass being used in lieu of gauze opposite the flame. Glass is brittle, and liable to crack from unequal expansion, and many persons do not think glass lamps so safe as the Davy, in consequence. The late George Stephenson contrived a safety-lamp, having both glass and gauze around the flame, known as the Geordy, or Stephenson lamp. The Davy lamp is perhaps the best known lamp for detecting the presence of a small mixture of fire-damp in the air of a mine.

Now, since fire-damp, choke-damp, and other gases are met with, in more or less abundance, in all coal mines, it becomes an important question as to how the bad and often fatal effects they are likely to produce, if not properly dealt with, may best be avoided. To this end it has sometimes been proposed to get them to combine chemically with some substance to be presented to them as they are given off; and only a short time ago a Mr. Wall had a proposition of this kind before the public. So far, however, the best mode of dealing with them appears to be to dilute them with very large quantities of fresh air, and to sweep them out of the mine by an energetic ventilation, as fast as they are given off or generated. After all, however, the natural laws and principles, operating in the production of ventilation in mines, have been less generally studied in England than on the Continent; and from this cause many mistakes have been made in the practice of ventilation in this country. New arrangements for the ventilation of mines have sometimes been made at great cost, and have not been found to answer when completed. In a few cases lives have been lost from this cause; in others, an inferior arrangement and ventilation have been produced, where by the application of these natural principles, a superior one might have been obtained at the same or even at a smaller cost.

NEW COAL REGIONS.

Within the past year four new coal districts have been opened up, and already give employment to upward of a thousand miners. These new fields are known as the Coalton district, the Corning district, the Del Roy district, and the Wheeling Creek Valley district.

The Coalton district is situate in Jackson county, and the coal is the equivalent of the Wellston shaft coal and the Jackson Hill coal. The bed, which ranges from three to four feet in thickness, lies 160 to 180 feet above the Jackson shaft coal—the lowest bed of the State series. The coal of this new district, is one of the purest and best in the State of Ohio, or in the United States, and is, perhaps, the best bituminous steam coal in the world. It is open, burning in character, hence is fitted for the smelting of iron in a raw state, for which purpose it has been extensively used for a number of years at the blast furnaces of the Milton Furnace and Coal Company, and of the Wellston Coal and Iron Company, situate at Wellston, the eastern terminus of the basin.

This region is reached by two newrailways—the Dayton and Southeastern and the Springfield Southern, both of which have been completed to the mines within the past eighteen months. The coal ranges from 2½ to 4 feet in thickness, the field being from 2½ to 4 miles wide, and about six miles long. The coal is thickest on the eastern margin of the basin, gradually thinning to the west and south, around the village of Coalton, where the mines are mainly located; the seam is level free, and the mines are drift openings. In passing eastward, however, along Horse Creek, the rise of that stream and the dip of the strata force the coal under water, a mile above the village of Coalton, and where the old Hamden road crosses the Dayton and Southern Railway, on the lands of Frank Scott. Between this point and Wellston, one slope and two shafts have been opened by sinking, the coal ranging from 3½ to 4 feet in thickness, and showing a quality unsurpassed in excellence.

Although this is evidently disposed in a basin or trough of limited area, fully seventy million tons have already been proved, and there is good reason for stating that other, and equally valuable deposits, exist in the immediate neighborhood of the Wellston or Coalton tract. The Elk Fork coal, near the village of McArthur, is, beyond doubt, the equivalent of the Coalton seam; the two deposits are not only of equal thickness and quality, but they will doubtless be found to connect by some arm or basin, in the course of their mutual development.

The Corning coal-field is situate in the Sunday Creek Valley, in Perry county, in the heart of the great vein coal-field. The coal ranges in thickness from 8 to 12 feet, and is of the same quality, as it is the equivalent of New Straitsville, the Shawnee and the Nelsonville coals of the Hocking Valley. The mines are all shaft openings, sunk along the valley of Sunday Creek in the vicinity of Corning and Rendville, and range in depth from 40 to 70 feet.

The mines are reached by the Ohio Central Railroad, extending from Columbus to Corning, and in progress of completion from Corning to Toledo. This road which was projected in 1869, was laid out from Toledo to Pomeroy, and was then known as the Atlantic and Lake Erie Railroad. The panic of 1874 prostrated the energies of the original projectors, and the road lay partially completed until 1879, when the healthy revival of business brought forward new capital, and renewed energy. The company was reorganized as the Sunday Creek Valley Railroad Co., and the line of the road changed from Corning to Columbus. A few months later the road was again changed to its present name, the Ohio Central, with the object of extending the line from Corning to Toledo, which has now been accomplished.

The road is now being extended from Corning along the Sunday Creek Valley, eight miles south of Corning, thence it returns northward along one of the branches of Sunday Creek to Buckingham, within three miles of Corning. The region traversed by this road, from where it strikes the coal-field to its present terminus, passes through one of the most valuable coal districts in the world.

The Wheeling Creek Valley coal-field opens up the Pittsburg seam of coal, known here as the Ohio river coal. This coal has been mined and shipped to Cleveland from the mines of W. J. Rainy & Co., on the Ohio river, and from the Walnut Hill mines, two miles further up the river, for a number of years. Several new mines have been opened during the summer in this new coal-field, and as the coal. the equivalent of the Pittsburg bed is of good thickness, and fine quality, the new road piercing this district, and offering increased facilities for shipment, will stimulate development and reward the mining adventurer. The mines now opened are level free, the coal being accessible by drift mining. As the Pittsburg coal is remarkably free from wants, faults or other mining troubles, and the seam is met wherever it is due, a great coal region, and one of the best in the State, will soon develop itself along the Wheeling Creek Valley.

The Del Roy coal field is situated in Carroll county; the coal in progress of development is the No. 6 of the State geological survey, the equivalent of the Straitsville, Shawnee, Nelsonville, Sunday Creek, Monday Creek, Steubenville, Salineville, and Coshocton coals. This coal bed is one of the most persistent of the series comprising the great Allegheny coal field. It is nearly everywhere of suitable thickness, and of good quality. A large number of country banks have been opened for years in this new district, the coal being generally level free, and accessible by drift mining. The quality of the coal is good, comparing with the Massillon coal, and the bed ranges from four to five and one-half feet in thickness. The district, at some points, as the developments already show, is likely to be subject to "horse-backs," in the coal, caused by the sandrock which everywhere lies a few feet above the roof of No. 6, coming down and cutting into the seam, and usurping its place.

Four new firms have commenced operations at Del Roy, namely, the Empire Coal Co., the Connotton Valley Coal Co., the Del Roy Coal and Coke Co., and Samuel Allen. The Boston Coal Co., which, unfortunately, opened on the line of a "horse-back," has, after a considerable outlay of money in driving through it, suspended work for the present. The mines are level free, are drift openings, and are well laid out and opened so far as the work has gone. As the workings extend underground, however, more than ordinary mining intelligence will be required in directing their operation, in overcoming horse-backs, maintaining good and substantial hauling roads over the wavy coal floor, and in providing water-ways.

The coal is shipped from the mines at Del Roy to Canton, along the Connotton Valley Railroad—a narrow-guage track—whence it is reloaded in standard gauge flats, and shipped by the valley road to Cleveland and Akron. The Connotton Valley road is now in course of construction from Canton to Cleveland, and an extension from Del Roy southward to Sherrodsville, seven and one-half miles, is also under way, which, when completed, will cut deep into the heart of an undeveloped district.

The Del Roy coal field is destined to play an important part in the future coal trade of Cleveland and the Lake. The coals of Massillon and the Mahoning valley, opened on the lower coal of the State series, are yearly approaching exhaustion. Ten years hence, and the magnificent block coal of the Mahoning valley will be as rare as it is valuable. There is no help for this, and new fields will have to be drawn upon to replace the supply, though no new field can replace the quality.

EARLY MINING NOTES.

In former report, sketches of the early development of our coal mines have been published from time to time, as I have been able to collect facts on the subject while traveling through the mining regions of the State visiting and inspecting the mines. A number of our pioneer mines still survive. Mr. Asaph Whittlesey, father of Col. Charles Whittlesey, of Cleveland, the eminent geologist, was one of the first miners of Northeastern Ohio, and Col. Whittlesey has published a very interesting account of the discovery and development of the coals of that part of the State. The Talmadge Coal Company, organized in 1838, opened a valuable mine on Coal Hill, which furnished most of the coal shipped to Cleveland, until the year 1845. The coal on this property was discovered by Mr. F. H. Wright, in 1825, while digging a ground-hog out from under a stump. The mine was opened by stripping, and the coal worked out with pick-axes. In 1838 experienced miners from Pennsylvania were employed to work the coal in a systematic manner. The father of Dr. J. S. Newberry, chief of the late geological survey, was also one of the pioneer miners of Northeastern Ohio, having opened a mine at Talmadge and shipped coal to Cleveland in the year 1828. In recording this fact in my annual report for the year 1877, I was agreeably surprised to receive the following letter from Mr. H. V. Bronson, who took the first boat-load of coal to Cleveland. The letter is worthy of being preserved:

PENINSULA, SUMMIT COUNTY, OHIO,
April 8, 1878.

ANDREW ROY, ESQ.:

SIR: Not long since I saw in the papers that in your annual report, as State Inspector of Mines, that the first coal shipped by canal to Cleveland was in the year 1828, and by the late Mr. Henry Newberry, of Cuyahoga Falls, father of Professor Newberry, of Cleveland. I took that coal to Cleveland for Mr. Newberry, it being 50 years ago since it was done. I was then in the seventeenth year of my age, and have resided in this place ever since 1824. There were three of us boys on the boat. One of them was about a year my junior, and now resides in one of the townships of Cuyahoga county, and became a successful inventor and business man. The other one was then in the twelfth year of his age, and is now a lawyer with a lucrative practice, in a beautiful growing city in an adjoining State. On the first day of January last, I made a New Year's call on Prof. Newberry, at his home in Cleveland. A few years ago I presented Prof. Newberry with a lump of the coal taken from one of the boat-loads of that coal. As this whole transaction is somewhat remarkable, I have taken the liberty to write you about it, especially as we three boatmen are natives of Cuyahoga county.

Yours, respectfully,
H. V. Bronson.

Col. Charles Whittlesey, on the other hand, disputes with Prof. Newberry the priority of developing the coal mines of this part of the State. The following extract, from the published papers of Col. Whittlesey, is of great interest:

"Coal was discovered in Tallmadge, a mile west of the Centre, as early as 1810.

"It was visible in a small ravine on the land of Justus Barnes, where for many years blacksmiths from the adjacent county came and dug it from an open pit. The late Jotham Blakeslee, of Tallmadge, who only recently died, has often told me that he had procured it there from 1810 to 1819, and that no other coal was then known in Northern Ohio. As early as 1755, mineral coal had been discovered near Bolivar, in Tuscarawas county, by its being seen on fire, smoking and slowly burning in the ground, but I am not aware that it was dug or mined for use as fuel, in this part of the State, prior to 1810. My recollections of the place extend to 1819 or 1820, when my father, Asaph Whittlesey, and Samuel Newton, purchased the property of Barnes, and soon drove an entry into the bluff. The seam was four feet thick, and from this time was regularly mined. Francis H. Wright not long afterward opened a mine on his land half a mile north, at the eastern base of Coal Hill. About 1826 or 1827, Henry Newberry, of Cuyahoga Falls, opened a bank at the Corners, half a mile farther north.

"In the year 1838, Coal Hill, which was owned principally by Aspah Whittlesey, Daniel Upson and F. H. Wright, was put into a corporation under the name of the "Tallmadge Coal Company." A tram railway to the canal furnished most of the coal brought to Cleveland until 1845. As soon as the canal was made navigable to Lock 19, north of Akron, in 1828, Whittlesey and Newton took coal there with teams to be shipped, and the business was continued until 1832, when the canal reached the coal fields near Massillon, which were on its banks, and were worked by Cyrus Mendenhall. Professor Newberry, of the State Survey, has repeatedly claimed orally and in print, for himself and his father, the merit of originating the coal business of Cleveland. The late Mr. Newberry, of Cuyahoga Falls, took coal by teams to the canal in 1829, possibly in 1828, but was neither the originator, or a large operator, in that line, or any other branch of the coal business. He did not reside in Ohio prior to 1824, when the learned Professor was about eight years of age; and even in 1828-9 was certainly too young to engage largely in such operations."

The following extract, from the writings of Col. Whittlesy, in reference to the first use of raw coal in the blast furnaces of the United States, in the reduction of iron ore, is also of very great interest:

A sharp correspondence occurred, in 1869, between the partisans of the Clay furnace, and those of the Lowell furnace, as to their priority in the use of raw coal. The credit of making the first iron with raw bituminous, or semi-bituminous, coal, in the United States, belongs to one of these firms. An account of the blowing in of the Lowell furnace, on the 8th of August, 1846, may be seen in the *Trumbull Democrat*, of Warren, dated August 15, 1846, where it is stated that to "these gentlemen (Wilkinson, Wilkes & Co.) belongs the honor of being the *first persons in the United States* who have succeeded in putting a furnace in blast with *raw bituminous coal*." According to Mr. Wilkes, writing from Painesville, April 2, 1869, this furnace was run with coke several months, but at what time he does not state. It is admitted that Mr. David Himrod, now of Youngstown, produced the *first metal*, with raw coal, about the close of the year 1845, and has continued to use it ever since. The friends of Wilkinson & Co. claim that it was an accident, and a necessity, while their works were built and intended for raw coal. Without attempting to settle the question to whom belongs the most merit for this first success, all iron masters, and every one who takes an interest in the enormous business which has arisen from the enterprise and intelligence of these firms, must feel willing to regard them as public benefactors. There are said to be at the present time thirty-seven (37) furnaces, nearly half the number there is in Ohio, working on that fuel, on the waters of the Mahoning and the Shenango. Most of them have business relations with Cleveland. The metal produced is largely from Lake Superior ore, and, for variety of uses, has not its equal in quality in any part of the world, excepting only iron made with charcoal, from similar ores. That made with coke, must, of necessity, be inferior in grade; but for rails, and many other uses, there is a large market for second and third-class metal.

The first coal mined at Mineral Ridge occurred in the year 1835, the mine being situate in Coal Run, on the south side of the village, on the land of Michael Ohl. In 1833, Roger Hill, a Pennsylvanian, who had mined coal in Beaver county, of that State, moved to Mineral Ridge. He showed Mr. Ohl the coal exposed in the run, and advised him to open a mine. Two years later Hill commenced work for Ohl, and, in drifting into the hill, found a seam of coal four feet thick. He selected a smooth, square, and heavy piece, and carried it home to test its quality. The piece refused to burn, and was pronounced by Hill to be bastard cannel coal, or blackstone. The other parts of the seam proved to be of good quality, and the "blackstone" was left unwrought in the mine, forming the floor of the bed. The coal found a ready sale for blacksmithing purposes, and for household use.

John Lewis, a miner, originally from Monmouthshire, England, had settled in Mineral Ridge in the year 1854. One day, while sinking a hole in the floor of his working place, to set up a prop, he was struck with the similarity of the blackstone to the black-band ore he had mined at the Victoria mines, in the old country. He stated to Messrs. Ward and company his opinion of the coal floor that it was a valuable deposit of black-band ore. Messrs. Ward and company directed the English miner to mine and calcine a quantity of the ore. The result proved the correctness of the miner's practical knowledge. All the old coal openings were now re-opened and searched over for the black-band, and it was lifted in every working place, old and new.

It was not until the year 1868, however, that the real value of the black-band was fully appreciated. For a number of years after its discovery the art of calcining it and using it prudently, in connection with the lake ores, in the blast furnace, was not well understood. Since that time, however, the iron made from a judicious mixture of the black-band ore of the Mahoning Valley has taken the front rank in the iron market of the United States, and is everywhere known and prized as "American-Scotch."

The first coal shipped to Cleveland from Mineral Ridge took place in the year 1857, from the mines of Messrs. Rice, French, Cook & Co. The shaft, afterwards known as the old Peacock mine, was followed by the opening of the Morris and Price slope. Shortly afterward the Tod and Wells shaft was sunk. The coal of this district has always maintained a good reputation as a house fuel, and as specially adapted for rolling-mill purposes and for the generation of steam.

COAL-CUTTING MACHINERY.

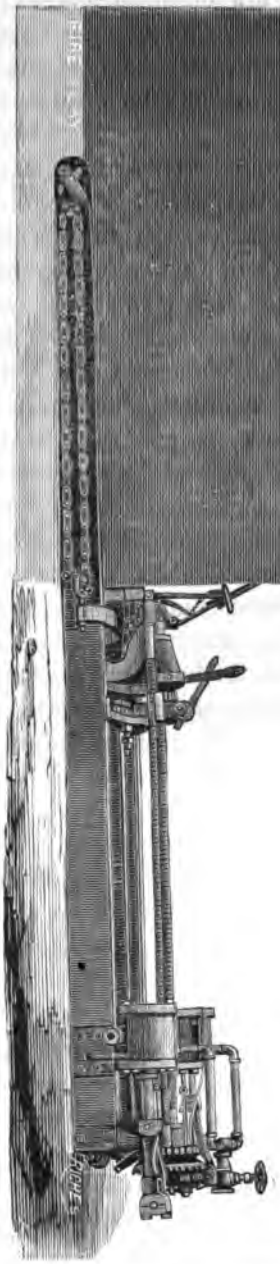
There seems to be good reason for stating that coal-cutting machinery is destined, ere long, to become of general use in coal-mining. In Ohio the Lechner machine has been in continuous use in several of the mines of the Hocking Valley for upwards of three years. Since its introduction it has been improved in one or two important particulars, and will, no doubt, be further improved from time to time, until systematic perfection is reached. Coal-cutting machinery possesses marked advantages to the working miners over hand-mining, one great advantage being in the easy method of undercutting. As this is done almost invariably on the bottom of the coal-seam, the miner is required in using the pick to sit on the ground, which is often wet and always damp; and in reaching back with the pick, in holeing, he lies down on his side, his shoulder resting on his thigh; rheumatism and lumbago attack him in consequence, while the work of undercutting itself, in this constrained position, is not only the most laborious, but it is the most exhausting work to which the human frame can be put. Another advantage consists in the increased purity of the mine atmosphere. The machine is worked by compressed air, which, liberated at the working faces, forms a discharge or return current, which carries away the gases as fast as they are generated.

In the mines of Great Britain, mining machinery has been introduced for many years, numerous inventions having been made and numerous patents granted, but very few of the machines have been found in practice to reduce the cost of mining. During the past year, however, renewed effort has been made to perfect coal-cutting machinery in that country, and some of the best English mechanics have been shipped to Germany and our own country.

During the "mining troubles" in the Hocking Valley last summer, a feeling prevailed outside of this mining region that the miners were fighting against the introduction of mining machines. This impression was all wrong. No intelligent miner will oppose, but will welcome the use of machinery in coal-mining, for it will come as the friend of the miner. There may be disputes in regard to wages with coal-cutting machines, as there are disputes now in the old method of hand-mining, but no serious opposition will be placed in the way of a coal-cutting machine in Ohio or elsewhere, and even if the miners should, in defiance of good sense, and their own true interests, attempt to do so, they would simply attempt an impossibility and throw away their labor, for if coal-cutting machinery can be made to reduce the cost of getting the coal without reducing the wages of labor, it will as surely supplant hand-labor as labor-saving machinery has hitherto done in every other department of human industry. If, on the other hand, these coal-cutting machines cannot reduce the cost of coal getting they will prove a failure, no matter how ingeniously they may be got up.

The Lechner machine is an Ohio invention, having been patented by Mr. Francis M. Lechner, of Columbiana county, July 20, 1877. This coal-cutter, as are all other mining machines, is worked by means of compressed air. The coal is cut or undermined in the bottom of the vein by means of a horizontal revolving bar, 3 feet in length, to which a number of sharp steel points are attached, which grind the undercuttings to dust. The undercutting is made five fieet deep and four inches in thickness, the debris being removed as fast as it is formed by revolving chains or scrapers. As soon as an attack is completed, the cutting-machine is withdrawn and shifted over three feet, and another depth of five feet undercut. This operation is repeated until the whole breadth of room has been undermined, when the machine is placed on a truck and hauled into an adjoining room.

The Lechner machine, as now inpjoved, is only 20 inches in height, and hence is adapted to every seam of coal of workable thickness. It is now in use at the Bellville and Grape Creek mines, in Illinois.



LECHNER'S COAL-CUTTING MACHINE AT WORK.

Another coal-cutting machine, which has been in use in the coal mines in Illinois for five or six years, and which is now in use in the mines of the Hocking Valley and Mahoning Valley regions of Ohio, called the Harrison coal-cutter, is perseveringly at work to solve the problem of machine-power in coal-getting. This machine, called the "Iron Man" by the miners, was first introduced in the mines of the Diamond Coal and Mining Company, in the State of Illinois, in 1875. Since its introduction it has been greatly improved. During the past summer the Chicago, Wilmington and Vermillion Coal Company, one of the wealthiest mining corporations in the West, put ten (10) of these machines at work in their mines in Illinois, fitting up a blowing-engine of 50-horse power for supplying the coal-cutters with compressed air. The coal-cutter, operated by a piston which works straight out from the cylinder, consists of a pick which has two points. This pick, which is about 8 pounds weight and ten inches long, is made out of solid steel. The pressure of air for working the push ranges from 10 to 60 pounds. There is some trouble experienced in regulating the length of strike of the pick, and the number of blows per minute to be delivered on the coal. This is a matter, however, which can and will be properly regulated in time.

These are the only machines which have yet been applied to coal-mining in the United States. Our British friends, however, having been struggling with this problem for nearly a century, and first and last have patented upward of 100 improved coal-cutters, yet, to-day the mass of England's coal is cut with the brawny muscles of her subterranean sons of toil, and it is likely to be so cut for many years to come.

CHECK-WEIGHMASTERS.

During a visit to the Mahoning Valley mines, in the month of August, one of the parties interested in the rent, or royalty of the coal, mined by the Church Hill Coal Company, complained to me that the weights of coal were not satisfactory either to himself, his associates in the royalty of the mine, or to the miners. I gave him a copy of the statute, and told him the law provided a remedy in the appointment of a check-weighmaster. Those interested in the royalty of the coal, and the miners, jointly, shortly afterwards employed a check-weighmaster. The company objected to the party selected, on the ground that he was not selected so much to see the coal weighed in the interest of the miners and landowners, as to provoke a quarrel with the company's weighmaster, and refused to run the mine. The miners then, on their own account, appointed another party as check-weighmaster for themselves. The company objected again, stopped the mine and notified the miners, through their superintendent, that no check-weighmaster would be allowed. The miners thereupon called a meeting, and as a result, sent me the following communication:

> CHURCH HILL, OHIO, *September* 3, 1880.
>
> ANDREW ROY, ESQ., *State Inspector of Mines:*
>
> SIR: After having appointed a check-weighmaster, at the Church Hill Coal Company's mine, and said check-weighmaster having been refused free access to the scales, we, the miners of said mines, demand of you to enforce the law of the State.
>
> (Signed by the committee on behalf of the miners of the said mines)
>
> JOHN SANDS,
> BENJAMIN WILLIAMS.

On receiving this communication, I called upon the members of the Church Hill Coal Company, at their office in Youngstown, to talk over the situation, and learned that their objection to allowing a check-weighmaster at the scales was not through any desire to disregard the mining law of the State, but because a proper person had not been appointed by the miners collectively, or by the miners and landowners jointly. I informed the president of the company that the parties in interest were the proper judges as to the fitness of the persons selected for check-weighmaster, that the duties of a check-weighmaster were defined by law, and that when such employe of the miners and landowners exceeded his duty, he could then be removed. An understanding, satisfactory to all concerned, was reached, and the mine resumed work with a check-weighmaster, and a "Billy fair-play," a machine which is placed under the screen to catch the slack, or fine coal from the mine cars as they are dumped into the chutes. This fine coal, which is unmerchantable, is deducted from the weight of the car, and the honest and dishonest loaders are thus placed on equal footing. Formerly the amount of slack in each car, exceeding 100 pounds in weight, was guessed at by the weighmaster, but the "Billy" detects the true amount. Those miners who are in the habit of loading dirty coal, are now as angry with the "Billy" as they formerly were with the weighmaster of the company.

A few weeks later I was again called to the Mahoning Valley to see a check-weighmaster, appointed at the Halliday Slope, in Trumbull county, the officers in charge of this mine having refused a check-weighmaster, appointed by the miners, access to the scales. Before my arrival, the miners had withdrawn their demand for a check-weighmaster, having become dissatisfied with the results of the operations of the "Billy fair-play" at the mines of the Church Hill Coal Company.

Some weeks before the misunderstanding arose between the Church Hill Coal Co. and their employes, regarding the check-weighmaster, the miners employed in the Brookfield Coal Co.'s mine, jointly with the parties interested in the royalty of the coal, had employed a check-weighmaster to see the coal fairly weighed. The company refused him access to the scales, and the miners, indignant at such treatment, struck. After several weeks' idleness they returned to work without a check-master. This is not the proper course to pursue on the part of the miners when refused access to the scales. They should continue work, and notify the Mine Inspector of the action of the company. In nine cases out of ten explanation and mutual concession on the part of both, will adjust the difficulty without a strike. In any event, it is the duty of the Mine Inspector, when properly notified, to enforce the law, and so long as I hold the office, I will not hesitate to enforce it by appeal to the courts when no other recourse is left me. A wealthy corporation can starve the miners into submission, but cannot starve the State of Ohio. Strikes, at best, are a questionable means for the redress of any grievance; their frequency and their folly have prevented many a necessary and proper concession. I trust there will be no more strikes because the operators of a mine refuse to all a person employed by the miners, collectively, or by the miners and landowners jointly, free access to the scales, but that in future cases of such refusal, appeal will be made to the Mine Inspector to enforce the law.

LEGISLATION FOR THE PROTECTION OF MINERS.

The first legislation had in the United States for the protection of the lives and safety of miners, was enacted by the Legislature of Pennsylvania. The anthracite coal mines of that State, owing to the steep inclination and great thickness of the veins, are very dangerous to human life. In 1869, the General Assembly passed a law providing for "The protection of the health and safety of persons employed in the mines of Schuylkill county," and under this law the Governor appointed one Inspector of Mines, to see that the provisions of the act were properly enforced and obeyed. The law had been in operation only a few months when the Avondale shaft, situate in Luzurne county, took fire. The mine had but one opening, and the whole underground force, numbering 109 souls, were suffocated to death by the gases formed from the combustion of the immense wooden structure surrounding the top of the shaft. At the following session of the Legislature, the mining law was amended, and made to extend to all the anthracite coal mines in the State. Under the new law, six Mine Inspectors were appointed by the Governor, and charged with the enforcement of the provisions of the act.

In April, 1871, the Legislature of Ohio followed that of Pennsylvania, and passed a law for the "regulation and working of coal mines," but as no provision was made for authorized official inspection of the mines, no attention was paid to the requirements of the act by the mine operators and their superintendents. On the 21st of March, 1874, however, the General Assembly amended the law by providing for official supervision of the mines. On the 6th of April, following, Gov. William Allen appointed myself Inspector of Mines, the new law making provision for the appointment, by the Governor, of one State Inspector of Mines, who should hold the office for four years. My term of office having expired April 6, 1878, Gov. R. M. Bishop appointed James B. Poston, of Hocking county, Inspector. Mr. Poston held the office until November 14, 1879, when he resigned, and Gov. Bishop commissioned David Owens, of Trumbull county, to fill the vacancy. The Senate failing to confirm the nomination of Mr. Owens, Gov. Foster reappointed me to the office, my commission bearing date February 12, 1880. I assumed the duties of the office on the 15th of February, and have since been employed visiting and inspecting the coal mines of the State, as often as my other official duties would permit, to see that the law was enforced and obeyed.

The State of Maryland, though possessing one shaft mine only, and but thirty-five mines, all told, followed Ohio, and enacted a law, in 1876, for the ventilation and inspection of the coal mines of the State. One State Mine Inspector is charged with the due enforcement of the mining law. In the spring of 1877, the Legislature of Pennsylvania corrected the blunder of the act of 1869, which confined the mines-inspection law to the anthracite coal mines of the State, and passed an act "providing for the means of securing the health and safety of persons employed in the bituminous coal mines of Pennsylvania." Under this law three Mine Inspectors are appointed by the State, to see that this law is properly complied with. This gives Pennsylvania nine Inspectors of Mines—three for the soft coal and six for the hard coal regions.

Indiana and Illinois have, also, mine inspection laws upon their statute books. In the State of Indiana, the Mine Inspector, though a State officer, and appointed by the Governor, is not a salaried official, but is authorized to charge $5.00 for every mine inspected, and the mine owner is required to pay the cost, but no mine is required to be inspected more than three times in each year. In the State of Illinois there is one Mine Inspector for every county in which coal is mined, and the County Surveyor is made Mine Inspector by law. He is empowered, in the discharge of his duties as County Inspector of Mines, to call to his assistance one practical miner of acknowledged intelligence and judgment. As the County Surveyors have, very generally, no great desire to venture into the bowels of the earth, and traverse, for hours, in a stooping posture, the many and intricate galleries of a coal mine, to reach the underground chambers of the miners, the dangers of whose labyrinthian workshops they cannot comprehend, the work of mine inspection in this State is left with the deputies or assistants of the county surveyors.

No other States of the Union, besides those already named, have yet enacted laws for the protection of the lives and safety of their underground miners, but every mining State will do so in time, as their mineral treasures become more and more developed, and the dangers to life, health and limb in the mines attract the public attention.

In Great Britain, the first act for the inspection of mines of the United Kingdom was passed in the year 1850. The law, as first enacted, was very imperfect. It provided for the appointment of two Mine Inspectors, whose duties consisted mainly in inspecting the mines, and in reporting their condition, without having authority to point out danger or apply means of safety. The law has repeatedly been amended, and at present 12 Inspectors and 12 Assistants are charged with enforcing the provisions of the law. The present law was enacted in 1872.

MINING SUITS.

During the four years of my first term of office, a number of suits were entered against parties operating coal mines, for neglect or refusal to comply with the provisions of the mining law. In prosecuting these cases attorneys were employed, a number of whom have not yet been paid in full. On the 15th of November, 1877, the unpaid account amounted to $673.90. In a communication to the Chairman of the Finance Committee of the House, I made a statement of the indebtedness of the State in the prosecution of suits, as follows:

OFFICE OF STATE INSPECTOR OF MINES,
COLUMBUS, *April* 1, 1878.

HON. ROSS J. ALEXANDER,
Chairman Finance Committee, House of Representatives:

DEAR SIR: The amount, as per bills herewith enclosed, for attorneys' fees in the various mining suits to compel obedience to the mining law, is $673.90, and I respectfully ask that the amount be appropriated by the Legislature in payment of the same.

Yours truly,
ANDREW ROY,
Mine Inspector.

The General Assembly appropriated but $453 for the payment of this account. The amount of unpaid bills to date, including balance due after the payment of the $453 stated above, is $270.90. All the bills will be laid before the Finance Committee on the assembling of the Legislature in January next.

As it may become necessary at any time to enter suit against the owners of mines to compel obedience to the law, an appropriation should be made for the payment of attorneys' fees in advance of action by the Mine Inspector, or the contingent fund of the inspector should be made large enough so that he could pay attorneys out of that fund.

RECOMMENDATIONS.

The enactment of the mining law was regarded by many as an experiment likely to lead to no good results; while a large majority of the mine owners and operators of the State regarded the act as an unnecessary and unwarranted interference with the business of coal mining, and as contrary to the genius and spirit of American institutions. The successful operation of the law soon dispelled the fears of the mine owners, and all opposition to the inspection of mines by State authority has long passed away forever.

That the law was defective, and would require amendment in many of its more important features, was well known to those who sought its passage. But as it was the best that could be had at the time, the friends of the measure deemed it proper to give it a fair trial, and its successful application would alike disarm opposition to official supervision of the mines in the interest of the lives and safety of our subterranean workmen, and to the proper and necessary amendments required to perfect the law. Having been charged with the practical execution of the law, almost continuously since the creation of the office of Mine Inspector, I respectfully but earnestly call attention to the following defects of the act, and to the recommendations for the perfection of the law:

The term of office of the Mine Inspector is for four years, and experience has proved that it should not be for a less period. The work of inspection is so important, and the underground excavations are so numerous, distant and extensive, that more than two years of active work are required to make anything like a thorough examination of the condition and operations of the coal mines of the State. Indeed, no inspector, single-handed, can do the work required by the law. In Pennsylvania there are nine Inspectors of Mines—three (3) for the bituminous mines and six (6) for the anthracite mines. In Maryland there is one (1) inspector, whose labors extend to but two counties and to less than 40 mines. In Indiana, there is one inspector, and the mines and coal output do not reach ⅓ that of Ohio. I recommend that the State be divided into two inspection districts, or that provision be made for the appointment of an Assistant Inspector of Mines. The manner of appointing the Mine Inspector ought, also, in my judgment, to be changed, by requiring all applicants for the office to appear before a board of examiners and pass a satisfactory examination, and receive a certificate of competency, before being eligible to fill the office. This is the law in Pennsylvania; it keeps away mere politicians without practical experience, as none such could pass examinations. None but mining experts—men trained to underground life from boyhood, and familiar with every system of mining and ventilation ought, under any circumstances, to be selected or be eligible to fill the office of Mine Inspector in this or any other State. A person practically unacquainted with the gloom and danger of mining, instead of being able to point out danger and propose means of safety, during a visit to a coal mine, has to place himself in the care of some of the underground workmen, or he would lose himself among its labyrinthian chambers, and perish miserably.

Section 296 of the Revised Statues (Inspector of Mines) which provides for the surveying and mapping of mines, requires the mine-owner or his agent, in addition to filing a map or plan of the mine with the inspector, to file a statement or plan of the progress of the workings every four months. In my judgment, there is not, in the present state of mining, any necessity for extending the maps of mines in the office of the Mine Inspector every four months, nor is it possible for the inspector to extend the maps or mines every four months, nor every twelve months, even, for want of the necessary time to do such work. If proper plans of the workings of mines were required to be kept in the offices of the respective mine-owners at the mines, and the workings extended every six months, said plans to be open to inspection upon application of the Mine Inspector, and a tracing of any mine to be furnished the inspector on demand, every purpose contemplated by the mining law would be fully accomplished.

Sections 298, 299, 300, 301 and 302, as also section 305 of the law, have no penalties attached for any violation of their provisions, except the remedy of injunction to prevent the working of a mine with more than ten (10) men at once, until the law is complied with, which is too severe and too absurd a remedy, under the circumstances. A penalty by fine and imprisonment should be attached to each of these sections. The remedy of injunction should be applied only in cases of sudden or immediate danger, as in the case of a mine having but one means of exit, or where there is danger of inundation of water, or accumulations of standing gas.

Section 298 requires amendment in regard to the distribution of the air of mines. Instead of requiring the whole current to circulate to the face of each and every working place in a mine, as a literal construction of this provision would seem to indicate, the law should require the current to pass within a given distance of the working faces, this distance in no case to exceed one hundred feet, and all break-throughs, air-ways or openings, of whatsoever nature, which allow the air to leak or spill before it reaches the interior break-throughs, should be closed and made thoroughly air-tight. If this were done, 66 cubic feet of air per minute per person employed in a mine, which is the amount required by the anthracite mining law of Pennsylvania, would suffice for every coal mine in Ohio, except such as generate copious volumes of fire-damp. All bosses of mines, whether the workings under their charge give out fire-damp or not, should be required to measure the amount of air in circulation, not only at the intake and upcast, but also at all the interior air-ways, and to forward the result of such measurements to the Inspector of Mines at least once in every two weeks. The mine boss, or his assistant, should also be required to inspect and pass through all the air-courses of the mine, once a day, to see that they are free and unobstructed for the easy flow of air. Every mine coming within the provisions of this statute, whether shaft, slope or drift, and no matter how limited may be their requirements as to ventilation, should be provided with artificial means of moving the circulating current of air. The natural forces seldom suffice during the most favorable seasons of the year, for even the smallest and least extensive mine workings. The air-courses of mines should have a sectional area of fully thirty feet.

The traveling-ways of slope-mines are, in the majority of cases, unfit for the passage of miners to and fro while fans are in motion. The miners are compelled to walk up the slope behind the loaded train, or ride upon the loaded cars, in violation of law. Traveling-ways should be cut on the side of all slopes at least two feet wide. The entries and traveling-ways of mines have also, in many cases, no man-holes or refuge places for travelers to enter as trains pass to and fro. Where the galleries of mines are 8 and 9 feet wide, there is generally space between the pillar and track for the safety of travelers; but where the galleries are only 6 feet wide, as in the case of all mines opened on the Pittsburg coal, in the Bellaire district, there ought to be man-holes cut in the pillars every 50 or 60 yards. Moreover, all hauling-roads and traveling-ways ought to be inspected by the boss, or his assistant, once a day.

When a mine is approaching the abandoned workings of an adjoining mine, filled with water, or noxious gases, bore-holes should be required to be made in advance of the workings.

The lack of penalties, to a number of the most important provisions of the law, not only made those provisions a dead letter, but throws obstacles in the way of the timely and effective enforcement of such sections as are of binding effect. In amending the law, care should be taken that nothing be incorporated into the new provisions that is not of practical and immediate application. Unnecessary and unduly severe provisions do no good, but much harm. Every section of the act should be made simple and concise, meaning what they say, and the letter and spirit of the law can then be intelligently and effectually enforced. I have copied, for publication in this report, from the revised statutes, all laws relating to mines and mining, now in force in this State, and have, in addition, procured a copy of the mining law of Pennsylvania governing the bituminous mines of that State, also an abstract of the British mining law, for comparison with our own State law.

In order to satisfy myself, by the highest legal authority in the State, as to the imperfect condition of several very important provisions of the statute, I sent the following communication to the Attorney-General:

STATE OF OHIO, OFFICE OF STATE INSPECTOR OF MINES,
COLUMBUS, *November* 10, 1880.

HON. GEORGE K. NASH, *Attorney-General:*

DEAR SIR: I desire your opinion as to whether persons who violate, or neglect to comply with the provisions of sections 296, 297, 298, 299 and 300, of the revised statutes, are subject to criminal prosecution under section 6871.

Very truly yours,
ANDREW ROY,
State Inspector of Mines.

To this communication the Attorney-General sent the following reply:

STATE OF OHIO, ATTORNEY-GENERAL'S OFFICE,
November 11, 1880.

HON. ANDREW ROY, *State Inspector of Mines, Columbus, Ohio:*

DEAR SIR: Your favor calling my attention to sections 296, 297, 298, 299, and 300, of the Revised Statutes, and asking whether any penalties for the violation of these sections can be enforced, by criminal prosecution, has been received.

These sections provide that certain things intended for the safety of those employed in mines shall be done, and makes it unlawful to do certain other things. But as these sections now stand, it occurs to me that no penalty is prescribed for omitting to do the things in them required to be done, or for the doing of the things in them prohibited.

It was probably the intention of the Legislature, in the enactment of section 6871, Revised Statutes, to prescribe a penalty for a violation of the sections of the statute referred to by you, in your communication to me. I am of the opinion, however, that this section fails to meet the case. If it had contained the words "or failed to comply, in any particular, with the provisions of sections 296, 297, 298, 299, or 300, of the Revised Statutes of Ohio," penalties could then be enforced for the violation of these sections, or any one of them.

Yours, truly,
GEO. K. NASH,
Attorney-General.

LAWS RELATING TO MINES AND MINING.

OHIO.

[From the Revised Statutes, Vol. 1, Chapter 9, page 247].

INSPECTOR OF MINES.

SECTION 290. The inspector of mines shall be appointed by the governor by and with the advice and consent of the senate, and shall hold his office for four years; and no person shall be appointed unless he is possessed of a competent knowledge of chemistry, geology, and mineralogy, and has a practical knowledge of mining engineering, and of the different systems of working and ventilating coal mines, and of the nature and properties of the noxious and poisonous gases of mines, particularly fire-damp.

SEC. 291. Before entering upon the discharge of the duties of the office, the inspector shall give bond to the state in the sum of five thousand dollars, with sureties to be approved by the governor, conditioned for the faithful performance of his duties; the bond, with his oath of office, and the approval of the governor indorsed thereon, shall be forthwith deposited with the secretary of state.

SEC. 292. The inspector shall give his whole time and attention to the duties of his office, and shall examine all the mines in the state as often as his other duties will permit, to see that the provisions of this chapter are obeyed; and the inspector may enter, inspect, and examine any mine in the state, and the works and machinery belonging thereto, at all reasonable times, by night or by day, but so as not to unnecessarily obstruct or impede the working of the mine, and to make inquiry into the state and condition of the mine as to ventilation and general security; and the owner and agent of such mine are hereby required to furnish the means necessary for such entry and inspection, of which inspection the inspector shall make a record, noting the time and all the material circumstances; and the person having charge of any mine, whenever loss of life occurs by accident connected with the working of such mine, or by explosion, shall give notice forthwith by mail or otherwise, to the inspector of mines, and to the coroner of the county in which such mine is situated, who shall hold an inquest upon the body of the person or persons whose death has been caused, and inquire carefully into the cause thereof, and shall return a copy of the finding and all the testimony to the inspector.

SEC. 293. The inspector, while in office, shall not act as an agent, or as a manager, or mining engineer, or be interested in operating any mine; and he shall annually make report to the governor of his proceedings and the condition and operation of the mines of the state, enumerating all accidents in or about the same, and giving all such other information as he thinks useful and proper, and making such suggestions as he deems important as to further legislation on the subject of mining.

SEC. 294. The inspector shall have an office in the state house, in which shall be carefully kept the maps and plans of all mines in the state, and all records and correspondence, papers, and apparatus, and property pertaining to his duties, belonging to the state, and which shall be handed over to his successor in office.

SEC. 295. There shall be provided for the inspector all instruments and chemical tests necessary for the discharge of his duties under this chapter, which shall be paid for on the certificate of the inspector and which shall belong to the state.

SEC. 296. The owner or agent of every coal mine shall make, or cause to be made, an accurate map or plan of the working of such mine, on a scale of not less than one hundred feet to the inch, showing the area mined or excavated, and the location and connection with such excavation of the mine of the lines of all adjoining lands, and the name or names of each owner or owners, so far as known, marked on each tract, a true copy of which map the owner or agent shall deposit with the inspector, and another copy of which shall be kept at the office of such mine; and the owner or agent shall, every four months thereafter, file with the inspector a statement and plan of the progress of the workings of such mine up to that date, which statement and plan shall be so prepared as to enable the inspector to mark the same on the original map or plan herein required to be made; and in case of refusal on the part of the owner or agent to make and file the map or plan, or the addition thereto, the inspector is authorized to cause an accurate map or plan of the whole of said mine, to be made at the expense of the owner thereof, the cost of which shall be recoverable against the owner, in the name of the person or persons making the map or plan, which shall be made in duplicate, one copy being delivered to the inspector and the other left in the office of the mine; and he shall, on being paid the proper cost thereof, on demand of any person interested in the working of such mine, or owner of adjoining lands, furnish an accurate copy of any map or plan of the workings of such mine.

SEC. 297. It is unlawful for the owner or agent of any coal mine worked by a shaft, wherein over fifteen thousand square yards have been excavated, to employ or permit any person to work therein, unless there are, to every seam of coal worked in each mine, at least two separate outlets, separated by natural strata of not less than one hundred feet in breadth, by which shafts or outlets distinct means of ingress and egress are always available to the persons employed in the mine; but it is not necessary for the two outlets to belong to the same mine; the second outlet need not be made until fifteen thousand yards have been excavated in such mine; and to all other coal mines, whether slopes or drifts, two such openings or outlets must be provided within twelve months after fifteen thousand yards have been excavated therein; and in case such outlets are not provided as herein stipulated, it shall not be lawful for agent or owner of any such mine to permit more than ten persons to work therein at any one time. In case a coal mine has but one shaft, slope, or drift for the ingress or egress of the men working therein, and the owner thereof does not own suitable surface-ground for another opening, he may select and appropriate any adjoining land for that purpose and for approach thereto, and shall be governed in his proceeding in appropriating such land by the provisions of law in force providing for the appropriation of private property by corporations, and such appropriation may be made whether he is a corporator or not; but no land shall be appropriated under the provisions of this chapter until the court is satisfied hat suitable premises cannot be obtained by contract upon reasonable terms.

SEC. 298. The owner or agent of every coal mine, whether shaft, slope, or drift, shall provide and maintain, for every such mine, an amount of ventilation of not less than one hundred cubic feet per minute per person employed in such mine, and as much more as the inspector may direct, which shall be circulated to the face of each and every working place throughout the mine; and all mines generating fire-damp shall be kept free of standing gas; and in all mines where fire-damp is generated, every working place shall be carefully examined every morning with a safety-lamp, by a competent person, before any of the workmen are allowed to enter.

SEC. 299. The owner or agent of every coal mine operated by shaft, in all cases where human voice can not be distinctly heard, shall, forthwith, provide and maintain a metal tube from the top to the bottom of such shaft, suitably calculated for the free passage of sound therein, so that conversations may be held between persons at the bottom and top of the shaft; and there shall also be provided an approved safety-catch, and a sufficient cover over-head, on all carriages used for lowering and hoisting persons, and in the top of every shaft an approved safety-gate, and an adequate brake shall be attached to every drum or machine used for lowering or raising persons in all shafts or slopes.

SEC. 300. No owner or agent of any coal mine operated by a shaft or slope shall place in charge of any engine used for lowering into or hoisting out of such mine persons employed therein, any but experienced, competent, and sober engineers; and no engineer in charge of such engine shall allow any person, except such as may be deputed for that purpose by the owner or agent, to interfere with it or any part of the machinery, and no person shall interfere or in any way intimidate the engineer in the discharge of his duties; and in no case shall more than ten men ride on any cage or car at one time, and no person shall ride upon a loaded cage or car in any shaft or slope.

SEC. 301. All the safety-lamps used for examining coal mines, or which are used in working any mine, shall be the property of the owner of the mine, and shall be under the charge of the agent thereof; and in all mines generating explosive gas, the doors used in assisting or directing the ventilation of the mine shall be so hung and adjusted that they will shut of their own accord, and can not stand open; and in all such mines the mining boss shall keep a careful watch over the ventilating apparatus and the air-ways, and he shall measure the ventilation, at least once a week, at the in-let and out-let, and also at or near the face of all the entries, and all such measurements shall be reported once a month to the inspector.

SEC. 302. No boy under twelve years of age shall be allowed to work in any mine, nor any minor between the ages of twelve and sixteen years, unless he can read and write, and in all cases of minors applying for work the agent of such mine shall see that the provisions of this section are not violated.

SEC. 303. In case any coal mine does not, in its appliances for the safety of the persons working therein, conform to the provisions of this chapter, or the owner or agent disregards the requirements of this chapter, any court of competent jurisdiction may, on application of the inspector, by civil action in the name of the state, enjoin or restrain the owner or agent from working or operating such mine with more than ten miners at once, until it is made to conform to the provisions of this chapter; and such remedy shall be cumulative, and shall not take the place of or affect any other proceedings against such owner or agent authorized by law for matter complained of in such action.

SEC. 304. When written charges of gross neglect of duty or malfeasance in office against any inspector is made and filed with the governor, signed by not less than fifteen coal miners, or one or more operators of mines, together with a bond in the sum of five hundred dollars, payable to the state, and signed by two or more responsible freeholders, and conditioned for the payment of all costs and expenses arising from the investigation of such charges, the governor shall convene a board of examiners, to consist of two practical coal miners, one chemist, one mining engineer, and one operator, at such time and place as he deems best, giving ten days' notice to the inspector against whom the charges are made, and also to the persons whose names appear first in the charges, and the board, when so convened, after having been first duly sworn truly to try and decide the charges made, shall summon any witnesses desired by either party, and examine them on oath, which may be administered by any member of the board, and depositions may be read on such examinations as in other cases; and the board shall examine fully into the truth of such charges, and report the result of their investigation to the governor; and the board shall award the costs and expenses of such investigation against the inspector or the persons signing the bond according to their finding against said inspector or in his favor, which costs and expenses shall include the compensation of such board, of five dollars per day for each member for the time occupied in the trial, and in traveling from and to their homes; and the attorney-general shall forthwith proceed to collect such costs and expenses, and pay the same into the state treasury, being in the first instance paid out of the state treasury, on the certificate of the president of such board.

SEC. 305. In all coal mines in the state, the miners employed and working therein, the owners of the land, or other persons interested in the rental or royalty of any such mine, shall, at all proper times, have full right of access, and examination of all scales, machinery, or apparatus used in or about such mine, to determine the quantity of coal mined, for the purpose of testing the accuracy and correctness of all such scales, machinery, or apparatus; and such miners, landowners, or other persons, may designate or appoint a competent person to act for them, who shall, at all proper times, have full right of access and examination of such scales, machinery, or apparatus, and seeing all weights and measures of coal mined, and the accounts kept of the same; but not more than one person on behalf of the miners collectively, or one person on behalf of the landowners, or other persons interested in the rental or royalty jointly, shall have such right of access, examination, and inspection of scales, weights, measures, and accounts at the same time, and that such persons shall make no unnecessary interference with the use of such scales, machinery, or apparatus.

SEC. 306. The provisions of this chapter shall not apply to, or affect any coal mine in which not more than ten men are employed at the same time; but on the application of the proprietor of, or miners in any such mine, the inspector shall make, or cause to be made, an inspection of such mine, and direct and enforce any regulations in accordance with the provisions of this chapter that he deems necessary for the safety of the health and lives of the miners.

[Vol. 2, Chapter 4, page 1630.]

OFFENSES AGAINST PROPERTY.

SEC. 6871. Whoever, knowingly, injures or interferes with any safety-lamp, air-course or brattice, or obstructs or throws open the doors or disturbs any part of the machinery of any mine, or disobeys any order given in carrying out the provisions of the law in reference to mines, or rides upon a loaded car or wagon in a shaft or slope of a mine, or does any act whereby the lives or health of the persons or the security of the mine and machinery are endangered, or being employed in any mine governed by the statute, neglects or refuses to securely prop or support the roof and entries under his control, or neglects or refuses to obey any order given by the superintendent in relation to the security of the mine in the part thereof under his charge or control, shall be fined not more than fifty dollars, or imprisoned in the county jail not more than thirty days, or both.

[Volume 2, Chapter 4, page 1632].

SEC. 6881. Whoever, in mining for coal or other minerals, willfully and without lawful authority, trespasses upon the lands of another, shall be fined not more than one hundred nor less than five dollars, or imprisoned not more than ten days, or both; and any continuation of such trespass, for twenty-four hours after the commencement of any prosecution under this section, shall be deemed a separate offense, and all prosecutions hereunder shall be commenced within one year from the time the offense becomes known to any owner of the property injured.

[Chapter 7, page 1640].

OFFENSES AGAINST PUBLIC HEALTH.

SEC. 6925. Whoever intentionally throws or deposits, or permits to be thrown or deposited, any coal dirt, coal slack, coal screenings, or coal refuse from coal mines, or any refuse or filth from any coal-oil refinery or gas works, or any whey or filthy drainage from a cheese factory, upon or into any of the rivers, lakes, ponds, or streams of this state, or upon or into any place from which the same will wash into any such river, lake, pond or stream, shall be fined in any sum not more than two hundred or less than fifty dollars.

[Volume, 2 Chapter 2, page 1666].

FRAUD.

SEC. 7070. Whoever sells and delivers any stone-coal, except at the weights and measures prescribed by law, shall be fined not more than fifty nor less than five dollars, or imprisoned not more than thirty nor less than five days.

[Volume 1, Chapter 11, page 1091].

MINES.

SEC. 4374. A person owning land adjoining a mine worked for the production of coal, ore, or other mineral substance, or a person having an interest in such mine, having reason to believe that the protection of his interest in the mine, or in like minerals on his adjoining land, requires it, upon making affidavit to that effect before a justice of the peace or other proper officer, may enter such mine, and have an examination or survey made thereof; but such examination or survey shall not be made until one day's notice thereof is given to the parties in interest, nor at unreasonable times, but in such time and in such manner as will least interfere with workings of the mine, if the same is being operated at the time.

SEC. 4375. When the affidavit has been made and notice given, the person in charge of such mine shall, on the application of the party giving the notice, transport by the ordinary method in use at such mine for entrance and exit, a surveying party of not more than five persons, furnish to such party a competent guide and supply them with approved safety-lamps; and for every person so transported, he shall be entitled to receive, from the person requesting such survey, the sum of fifty cents, unless the shaft exceeds two hundred and fifty feet in depth, when he shall be entitled to the sum of one dollar for each person, and five dollars per day for the guide.

SEC. 4376. If the parties working or occupying such mine sustain any damage, for which compensation should be made by reason of such examination or survey having been made at unreasonable times, or in an improper or unwarrantable manner, the person making the same or causing the same to be made, shall be liable therefor.

SEC. 4377. The parties working or occupying such mine shall not hinder or obstruct the examination or survey, when made at a reasonable time and in a reasonable manner, under a penalty of not less than fifty nor not more than five hundred dollars for each offense, to be recovered before a court of competent jurisdiction.

SEC. 4378. The party who makes the application for the survey, may, upon refusal of the owner or person in charge of the mine to comply with the foregoing provisions, recover judgment, as upon default, in a court of competent jurisdiction, against the owner of such mine, in such sum as such party may declare, under oath, he believes to be justly due him for coal or other mineral belonging to him, taken by the owner of such mine without his permission; and the statute of limitations shall not be operative as against such claim; but the demand and refusal to enter such mine, shall be first proven to the satisfaction of the court or jury, and the refusal of the person in charge of the mine, shall be held to be the refusal of the owner.

SEC. 4379. The provisions of this chapter shall be available to any person who, on his oath, states that he is the owner or authorized agent of any owner of land which he believes contains coal, or other valuable mineral substance, within one mile of such shaft, although it do not adjoin any mine of the owner of such shaft; the affidavit required shall be sufficient if it state that the lands in which the affiant is interested are in the vicinity of such shaft, and not more than one mile distant therefrom; and service upon any owner or superintendent of such shaft shall be sufficient.

[Volume 1, Chapter 20, page 1103].

WEIGHTS AND MEASURES.

SEC. 4443. A bushel of the respective articles hereafter mentioned shall mean the amount of weight, avoirdupois, in this section specified, viz.:

Of coke, forty pounds.
Of bituminous coal, eighty pounds.
Of cannel coal, seventy pounds.

SEC. 4444. The standard bushel of stone-coal, coke and unslacked lime, shall contain twenty-six hundred and eighty-eight cubic inches; and the lawful measure for measuring such articles shall contain two bushels, and be of the following interior dimensions: Twenty-four inches diameter at the top, twenty inches at the bottom, and fourteen and one-tenth inches deep.

SEC. 4445. When facilities can be had, all sales of coal shall be by weight, and two thousand pounds, avoirdupois, shall constitute a ton thereof; but, where coal cannot be weighed, it may be sold by measurement.

SEC. 4446. Whoever sells stone-coal in violation of the provisions of this chapter shall be liable to the person to whom the coal is sold and delivered in treble damages, to be collected in a civil action before any court of competent jurisdiction; if the defendant in such action does not reside in the county where the mine is located, service may be had upon him by copy of the summons left at his place of business; and any judgment recovered in such case shall be a lien upon all property of the defendant, in the county, from the day of service; but this section shall not apply to any person or corporation mining or selling less than fifteen thousand bushels of coal annually.

[Vol. 2, Chapter 13, page 2077].

SCHOOL OF MINES.

SEC. 8435. That the trustees of the Ohio agricultural and mechanical college be and they are hereby required to establish in said college, a school of mines and mine engineering, in which shall be provided the means for studying scientifically and experimentally the survey, opening, ventilation, care and working of mines, and said school shall be provided with complete mining laboratories for the analysis of ores, coals and other minerals with all the necessary apparatus for testing the various ores and coals, and also with the models of the most improved machinery for ventilating and operating all the various kinds of mines with safety to the lives and health of those engaged.

(8436) SEC. 2. Said trustees may require one of the professors now authorized to be employed in said institution, to give instruction in the most improved and successful methods of opening, and operating, and surveying, and inspecting mines, and in the methods of testing and analyzing coals and other minerals, especially those found in the state of Ohio. It shall also be the duty of such professor to register all experiments made in testing the properties of coals and other minerals, and such results shall be published in the annual reports of said trustees. It shall also be the duty of said professor to preserve in a cabinet, suitably arranged for ready reference and examination, suitably connected with this school of mines, samples of the specimens from the various mines of the state, which may be sent for analysis, with the names of the mines and their localities in the counties from which they were sent, and the analysis and a statement of the properties attached. It shall also be his duty to furnish analysis of all minerals found in the state, and sent to him for that purpose by residents of this state.

(8437) SEC. 3. There is hereby appropriated out of the general revenue fund the sum of four thousand five hundred dollars, to be expended in providing apparatus, equipments, cabinets, etc., as mentioned in the first and second sections of this act.

SEC. 4. This act to take effect and be in force from and after its passage.

PENNSYLVANIA.

AN ACT

Providing the means for securing the health and safety of persons employed in the bituminous coal mines of Pennsylvania.

SECTION 1. *Be it enacted, etc.*, That the owner or agent of every bituminous coal mine or colliery, shall make, or cause to be made, within six months after the passage of this act, an accurate map or plan of the workings of such coal mine or colliery, on a scale not exceeding one hundred feet to the inch, and showing the bearing and distances, which shall be kept for use of the inspector, in the office at the mine of said coal mine or colliery; and said owner, or agent shall cause, on or before the tenth day of January in every year, a plan of the progress of the workings of such coal mine during the year past, to be marked on the original map or plan of the said coal mine or colliery, and the inspector shall have the right at all times to have possession of any such map or plan at the mines to draw a copy therefrom for his own convenience: *Provided*, If the owner or agent of any coal mine shall neglect or refuse, or from any cause fail, for the period of two months after the time prescribed, to furnish the said map or plan, as hereby required, or if the inspector shall find, or have reason to believe that any map or plan of any coal mine furnished in pursuance of the provisions of this act is materially inaccurate or imperfect, he is hereby authorized to cause a correct map or plan of the actual workings of said coal mine to be made at the expense of the owner thereof, the cost of which shall be recoverable from said owner, as other debts are recoverable by law: *Provided*, That if the map or plan, which he claimed to be incorrect, shall prove to have been correct, then aforesaid expenses shall be paid by the said inspector and may be recovered from him in like manner.

SEC. 2. It shall not be lawful, after six months from the passage of this act, for the owner or agent of any bituminous coal mine to employ any person at work within said coal mine, or permit any person to be in said coal mine for the purpose of working therein, unless they are in communication with at least two openings separated by natural strata of not less than one hundred and fifty feet in breadth, if the mine be worked by shaft or slope, and of not less than twenty-four feet, if the mine be worked by drift: *Provided*, If the mine be worked by drift, two openings, inclusive of air shaft, shall only be required, if the air shaft can be used for ingress and egress in case of emergency; and that not more than twenty persons shall be employed in the mine at any one time after the expiration of the six months until the second opening shall be reached and made available; and in case of furnace ventilation being used before the second opening is reached, the furnace shall not be placed within forty feet of the foot of the shaft, and shall be well secured from danger from fire by brick or stone walls of sufficient thickness and the mine while being driven for making and perfecting a second opening; the owner or agent shall provide and maintain a metal tube from the top to the bottom of the slope or shaft, suitably adapted to the free passage of sound, through which conversation may be held between persons at the bottom and at the top of the shaft or slope; also, the ordinary means of signalling to and from the top and bottom of the shaft or slope, and an approved safety-catch, and sufficient cover overhead on every carriage used for lowering and hoisting persons; and the said owner or agent shall see that sufficient flanges or horns are attached to the sides of the drum of every machine that is used for lowering and hoisting persons in and out of the mine, and also that adequate brakes are attached thereto; the main link attached to the swivel of the wire rope shall be made of the best quality or iron, and shall be tested by weights, or otherwise satisfactory to the inspector of mines of the district, and bridle chains shall be attached to the main link from the cross pieces of the carriage, and no single link chain shall be used for lowering or raising persons into or out of said mine, and not more than six persons shall be lowered or hoisted by the machinery at any one time; and only sober, competent and experienced engineers shall be employed.

SEC. 3. When a second opening is made, one opening shall be set apart exclusively for purposes of ingress and egress, and shall not be clogged or obstructed with machinery, pumps, or currents of heated air or steam; if the opening is a shaft it shall be fitted with safe and convenient stairs, at an angle of not more than sixty degrees descent, and with landings at easy and convenient distances; all water coming from the surface or out of the strata in the shaft, shall be conducted by rings or otherwise to be prevented from falling down the shaft so as to wet persons who are ascending and descending the stairway of the shaft; if the opening in a slope, it shall be provided with safe and available traveling ways.

SEC. 4. The owner or agent of every bituminous coal mine, whether shaft, slope, or drift, shall, within six months after the passage of this act, provide, and thereafter maintain, for every such mine, ample means of ventilation, affording one hundred cubic feet per minute, for each and every person employed in said mine, which shall be circulated around the main headings and cross-headings to an extent that will dilute, carry off, and render harmless the noxious gases generated therein; and all mines generating fire-damp shall be kept free of standing gas, and every working place shall be carefully examined every morning with a safety-lamp by a competent person before any workmen are allowed to enter.

SEC. 5. In order to better secure the proper ventilation of every coal mine and promote the health and safety of the persons employed therein, the owner or agent shall employ a competent and practical inside overseer, to be called mining boss, who shall keep a careful watch over the ventilating apparatus, the air-ways, traveling-ways, pumps and pump-timbers, and drainage, and shall see that, as the miners advance their excavations, all loose coal, slate and rock overhead are carefully secured against falling in or upon the traveling-ways, and that sufficient timber is furnished of suitable lengths and sizes for the places where they are to be used, and placed in the working places of the miners; and it shall also be the duty of the mining boss to measure the air current, at least once a week; at the inlet and outlet and at or near the face of the headings, and keep a record of such measurements, and report the same to the inspector of his district once in every month; the safety-lamps used for examining mines or which may be used in working therein, shall be furnished by and be the property of the owner of said mines, and shall be in the charge of the agent of such mine; and in all mines generating explosive gases, the doors used in assisting or directing the ventilation of the mine shall be so hung and adjusted that they will close themselves, or be supplied with springs or pulleys so they cannot be left standing open; and bore-holes shall be kept not less than twelve feet in advance of the face of every working place; and, when necessary, on the sides, if the same is driven towards and in dangerous proximity to an abandoned mine or part of a mine suspected of containing inflammable gases, or which is inundated with water.

SEC. 6. Any miners, workmen, or other person, who shall intentionally injure any shaft, lamp, instrument, air-course, or brattice, or obstruct or throw open air-ways, or carry lighted pipes or matches into places that are worked by safety-lamps, or handle or disturb any part of the machinery, or open a door and not close it again, or enter any place of the mine against caution, or disobey any order given in carrying out the provisions of this act, or do any other act whereby the lives or the health of persons, or the the security of the mines or the machinery, is endangered, shall be deemed guilty of a misdemeanor, and may be punished in the manner provided in the sixteenth section of this act; all machinery about mines shall be properly fenced off, and the top of each shaft and the entrance of every abandoned slope and air or other shaft shall be securely fenced off; and there shall be cut in the side of every hoisting shaft, at the bottom thereof, a traveling way sufficiently high and wide to enable persons to pass the shaft in going from one side of the mine to the other, without passing over or under the cage or other hoisting apparatus.

SEC. 7. If any person, firm, or corporation, is, or hereafter shall be, seized, in his, or their, own right, of coal lands, and it shall not be practicable to comply with the requirements of this act, in regard to drainage and ventilation, by means of openings on his or their own land, and the same can be done by means of openings on adjacent lands, he or they may apply, by petition, to the court of quarter sessions, of the proper county, after ten days' notice to the owner or owners, their agent or attorney, setting forth the facts under oath or affirmation, particularly describing the place or places where such opening or openings can be made, and that he or they cannot agree with the owner or owners of the land as to the amount to be paid for the privilege of making such opening or openings; hereupon, the said court shall appoint three disinterested and competent citizens of the county to view the grounds designated, and lay out from the point or points mentioned in such petition a passage or passages for air and water, not more than sixteen feet in diameter, by the shortest and most convenient route, to the coal of such person, firm, or corporation, preferring in all cases an opening through the coal strata where the same is practicable; the said viewers shall, at the same time, assess the damages to be paid by the petitioner or petitioners to the owner or owners of such land for the privilege of making said openings, which damages shall be fully paid before such opening is made; it shall be the duty of said viewers to give notice by at least three written or printed handbills, posted on the premises at least five days prior to the time of meeting to attend to the duties of their appointment, setting forth distinctly the time, place and object of their meeting, and also to give personal notice to the parties, their agents and attorneys, where it can be done, and shall within thirty days after their appointment make report of their proceedings to said court, stating the amount of damages awarded, accompanied by a map or plan of said openings; and if no appeal be taken to said court within ten days after notice to the opposite party in interest of the filing thereof, it shall be marked confirmed by the clerk, and the petitioner or petitioners may proceed to make said opening or openings; the pay of the viewers and other costs shall be the same as in road cases, and shall be paid by the petitioner or petitioners.

SEC. 8. As soon as practicable after the passage of this act, the persons exercising the office of presiding judge of each of the several courts of common pleas in the Fifth, Tenth, and Fourth judicial districts, shall appoint one reputable miner of known experience and in practice at the time, (in the Fifth district the president judge of the court of common pleas number one shall make said appointment), and the Governor shall appoint two mining engineers of like repute and experience and practice at the time, who shall constitute a board of five examiners, whose duty it shall be to inquire into the character and qualifications of candidates for the office of inspector of mines under the provisions of this act. The examiners first appointed, in pursuance of this section, shall meet in the city of Pittsburg, on the fifteenth day of May next, and, after being duly organized, having taken and subscribed before any officer authorized to administer the same, the following oath, namely: "We, the undersigned, do solemnly swear (or affirm) that we will perform the duties of examiners of applicants for appointment as inspectors of bituminous coal mines to the best of our abilities, and that in recommending or rejecting said applicants we will be governed by the evidence of qualification to fill the position, under the law creating the same, and not by any consideration of political or other personal favors; that we will certify all whom we may find qualified, according to the true intent and meaning of the act, and none others, to the best of our judgments;" shall proceed to the examination of those who may present themselves as candidates for said office; and they shall certify to the Governor the names of all such applicants as they shall find competent to fill the office, under the provisions of this act, which names, with the certificate and the oath of the examiners, shall be mailed to the Secretary of the Commonwealth, to be filed in his office, and shall be valid when recommended by four of the examining board. The qualifications of candidates for said office of inspector of mines, to be inquired into and certified by said examiners, shall be as follows, namely: They shall be citizens of the United States, of temperate habits, of good repute as men of personal integrity, shall have obtained the age of thirty years, and shall have had at least five years' experience in the workings of the bituminous coal mines of Pennsylvania, and upon the examination they shall give evidence of such theoretical, as well as practical, knowledge of the working of coal mines and noxious gases, as will satisfy the examiners of their capability and fitness for the performance of the duties imposed upon inspectors of mines by the provisions of this act. The board of examiners shall, also, at their said meeting, divide the bituminous coal counties of the State into three inspection districts, as nearly equal in regard to the labor to be performed as is possible, taking into consideration the number of mines and the extent of territory; at every subsequent calling of the board of examiners this division may be revised as experience may prove to be advisable. The board of examiners shall each receive five dollars per day and all necessary expenses, to be paid out of the State treasury, upon the filing of the certificates of the examining board, in the office of the Secretary of the Commonwealth, as herein before provided. The Governor shall, from the names so certified, appoint one person to be inspector of mines, for each district, as fixed by the examiners, in pursuance of the act, whose commission shall be for four years, to be computed from the fifteenth day of May next. As often as vacancies occur, by death, resignation, or otherwise, in said offices of inspectors of mines, the Governor shall fill the same, by appointment, for the unexpired term, from the names on file in the office of the Secretary of the Commonwealth, until the number shall be exhausted; and whenever this shall occur, the Governor shall cause the aforesaid board of examiners to meet, who shall examine persons that may present themselves for the vacant office of inspector, in the same manner as herein provided, and the board of examiners shall certify to the Governor one person, to be commissioned by him for the office of inspector for the unexpired term; and any vacancies that may occur in the examining board shall be filled in the district where the vacancy occurred. And every four years the Governor shall appoint two mining engineers as before, and shall notify the persons exercising the office of president judge of the courts of common pleas of three of the judicial districts of the State, containing bituminous coal mines, selecting them in such order as to allow each district an equal share of such appointments, each to appoint one miner, and the five so appointed shall constitute a new board of examiners, whose duties, term of service, and compensation, and vacancies that may happen, shall be the same as those first provided for by this section, and from the names that may be certified by them, the Governor shall appoint the inspectors provided for in this act. Nothing in this act shall be construed to prevent the re-appointment of any inspector of bituminous mines. The inspectors of mines shall each receive, for their services, an annual salary of two thousand dollars, to be paid quarterly, by the State Treasurer, and they shall each reside in the district for which they shall be appointed. Each inspector is hereby authorized to procure such instrument and chemical tests and stationery, from time to time, as may be necessary to the proper discharge of his duties, under this act, at the expense of the State, which shall be paid by the State Treasurer, upon accounts duly certified by him, and audited by the proper department of the State. All instruments, plans, book memoranda, notes, et cetera, pertaining to the office, shall be the property of the State, and shall be delivered to their successors in office.

SEC. 9. Each inspector of bituminous coal mines shall, before entering upon the discharge of his duties, give bond in the sum of five thousand dollars, with sureties, to be approved by the preident judge of the district in which he resides, conditioned for the faithful discharge of his duty, and take an oath (or affirmation) to discharge his duties impartially, and with fidelity, to the best of his knowledge and ability.

SEC. 10. No person, who shall act as a manager or agent of any coal mine, or as a mining engineer, or to be interested in operating any coal mine, shall, at the same time, act as an inspector of coal mines, under this act.

SEC. 11. For any injury to person or property, occasioned by any violation of this act, or any willful failure to comply with its provisions by any owner, lessee or operator of any coal mine or opening, a right of action, against the party at fault, shall accrue to the party injured for the direct damage sustained thereby; and in any case of loss of life, by reason of such violation or willful failure, a right of action, against the party at fault, shall accrue to the widow and lineal heirs of the person whose life shall be lost, for like recovery of damages for the injury they shall have sustained.

SEC. 12. The inspectors of bituminous coal mines shall each devote the whole of his time to the duties of his office; it shall be his duty to examine the mines in his district as often as possible to see that all the provisions of this act are observed and strictly carried out; and he shall make a record of all examinations of mines, showing the condition in which he finds them, the number of mines in his district, the number of persons employed in and about each mine, the extent to which the law is obeyed, the progress made in the improvement sought to be secured by the passage of this act, the number of accidents and deaths resulting from injuries received in the mines, and all other facts of public interest concerning the condition and progress of mining in his district, which record shall, on or before the first Monday of each month, together with all matters and things furnished him in accordance with the provisions of this act, be filed in the office of the Secretary of Internal Affairs, to be by him recorded and included in the annual report of his department; he shall also, from the time of his commission, make strict and careful inquiry and examination into the condition of the ventilation and drainage of the mines.

SEC. 13. That the inspectors may be enabled to perform the duties herein imposed upon them, they shall have the right at all times to enter any bituminous coal mine to make examination or obtain information; they shall notify the owners, lessees, or agents immediately of the discovery of any violations of this act and of the penalty imposed thereby for such violation, and in case of such notice being disregarded for the space of ten days, they shall institute a prosecution against the owner, owners, agent, or lessee of the mine, under the provisions of section sixteen of this act; in any case, however, where, in the judgment of the inspector of either district, delay may jeopardize life or limb, he shall at once notify the inspectors of the other districts, whereupon they shall at once proceed to the mine or colliery where the danger exists, and examine into the matter, and if, after full investigation thereof, they shall be agreed in the opinion that there is immediate danger, they shall apply, in the name of the commonwealth, to the court of common pleas of the county in which the mine may be located, for an injunction to suspend all work in and about such mine or colliery; whereupon, said court, if the cause appear to be sufficient, after hearing the parties and their evidence as in like cases, shall issue their writ to restrain the working of said mine or colliery until all cause of danger is removed; and the costs of said proceedings, including the charges of attorney prosecuting said application, shall be borne by the owner of the mine or colliery: *Provided*, that no fee exceeding the sum of twenty-five dollars shall be taxed in any one case for the attorney prosecuting such case: *Provided, further*, that if said court shall find the cause not sufficient, then the case shall be dismissed, and the cost shall be borne by the inspector instituting the proceeding, or the county, in the discretion of the court.

SEC. 14. Whenever, by reason of any explosion or other accident in any bituminous coal mine or the machinery connected therewith, loss of life or serious personal injury shall occur, it shall be the duty of the person having charge of such mine or colliery to give notice thereof forthwith to the inspector of the district, and if any person is killed thereby, to the coroner of the county, who shall give due notice of the inquest to be held; it shall be the duty of the inspector, upon being notified as herein provided, to immediately repair to the scene of the accident and make such suggestions as may appear necessary to secure the future safety of the men; and if the results of the explosion do not require an investigation by the coroner, he shall proceed to investigate and ascertain the cause of the explosion or accident, and make a record thereof, which he shall file as provided for; and to enable him to make the investigation, he shall have power to compel the attendance of persons to testify, and to administer oaths or affirmations; the cost of such investigation shall be paid by the county in which the accident occurred, in the same manner as costs of inquests held by the coroners or justices of the peace are paid.

SEC. 15. The court of common pleas of any county in the proper district, upon a petition signed by not less than fifteen reputable citizens, not less than five of whom shall be miners, owners, or lessees of mines, and with the affidavit of one or more of said petitioners attached, setting forth that any inspector of mines neglects his duties or is incompetent, or that he is guilty of a malfeasance in office, shall issue a citation in the name of the Commonwealth to the said inspector to appear on not less than fifteen days' notice, upon a day fixed before said court, at which time the court shall proceed to inquire into and investigate the allegations of the petitioners; if the court find that the said inspector is neglectful of his duties or is incompetent to perform the duties of his office or that he is guilty of malfeasance in office, the court shall certify the same to the Governor, who shall declare the office of said inspector vacant, and proceed in compliance with the provisions of this act to supply the vacancy; the costs of said investigation shall, if the charges are sustained, be imposed upon the inspector, but if the charges are not sustained they shall be imposed upon the petitioners.

SEC. 16. The neglect or refusal to perform the duties required to be performed, by any section of this act, by the parties therein required to perform them, or the violation of any of the provisions or requirements hereof, shall be deemed a misdemeanor, and shall, upon conviction, be punished by fine of not less than two hundred dollars, nor not exceeding five hundred dollars, at the discretion of the court; and all penalties recovered under this act shall be paid into the treasury of the State.

SEC. 17. The inspector shall exercise a sound discretion in the enforcement of the provisions of this act, and should the operator or owner be dissatisfied with any decision at which the inspector may arrive, it shall and may be lawful for such operator or owner to apply, by petition, to the court of quarter sessions of the county wherein such mine is located, and said court shall, thereupon, appoint three reputable, competent, and disinterested persons, whose duty it shall be to forthwith examine such mines, and hear the proofs and allegations of the inspectors and operator or owner, and make such report, under oath, to court, of the facts as they exist, together with their opinion thereon; and if said report sustains the decisions of the inspector, then the party making application to court shall pay the costs of such proceeding, and if the report is against such decision, then the inspector shall pay the costs, unless the court order otherwise. The report of the said board shall become absolute, unless exceptions thereto shall be filed within ten days after notice of the filing thereof to the owner, operator, or inspector, and if exceptions are filed the court shall hear and determine the same, and the decision shall be final and conclusive.

SEC. 18. The provisions of this act shall not apply to any mine where ten men, or a less number, are employed, or to any mine which does not generate fire-damp, black-damp, or other dangerous or noxious gases.

SEC. 19. All laws or parts of laws inconsistent with any of the provisions of this act are hereby repealed.

AN ACT

To amend an act entitled "An act to provide the means for securing the health and safety of persons employed in the bituminous coal mines of Pennsylvania."

SECTION I. *Be it enacted, etc.*, That the last clause of the eighteenth section of the act of General Assembly, entitled "An act to provide the means for securing the health and safety of persons employed in the bituminous coal mines of Pennsylvania", approved the eighteenth day of April, Anno Domini one thousand eight hundred and seventy-seven, after the word "employed", in the second line of said section, which is as follows: "Or to any mine which does not generate fire-damp, black-damp, or other dangerous or noxious gases," is hereby repealed.

GREAT BRITAIN.

ABSTRACT OF BRITISH MINING LAW.

Application of Act—Inspectors—Managers—Restrictions as to Employment Under Ground—Restrictions as to Employment Above Ground—Who may be Employed about an Engine—Penalty for Misrepresentation of Age—Wages not to be paid in Public House—Weighing—Prohibition of Single Shafts—Fencing Abandoned Mines—General Rules—Special Rules—Dangerous Practices not Expressly Prohibited—Penalties—Miscellaneous—Register, Returns, Plans, Abandonment of Mines, Notices, Coroners' Inquests—Exemptions—Thin Seam Mine, Saturday Half-Holiday, Ireland, Weighing Provisions, Single Shafts—General Rules.

1. The act applies to coal mines, mines of stratified ironstone, mines of shale, mines of fire-clay.

Definition of Mine.—The term "mine" includes every shaft in the course of being sunk, and every level and inclined plane in the course of being driven, for commencing or opening any mine, or for searching for, or proving minerals, and all the shafts, levels, planes, machinery, tramways, and sidings, both below ground and above ground, in and adjacent to a mine, and any such shaft, level, and inclined plane, and belonging to the mine. The term "shaft" includes pit. Where two or more parts of a mine are worked separately, each of such parts may, after notice, be constituted a separate mine for the purpose of the act. A Secretary of State, however, may object thereto, and the owner or agent must acquiesce in such objection, or refer the matter to arbitration.

3. The commencement of the act is, for England and Scotland, 1st January, 1873; for Ireland, 1st January, 1874.

4. Inspectors of mines are to be appointed by a Secretary of State, and a district to be assigned to each. The existing inspectors are to continue to act.

5. An inspector may not himself be, or practice, or be the partner of one who is or who practices, as land agent or mining engineer, or as a manager, viewer, agent or valuer of mines, or as arbitrator, in mining cases, and may not be otherwise employed in or about any mine, whether such mine is one to which the act applies or not.

6. In order to ascertain whether the provisions of the act are observed both above ground and below ground, the inspector is authorized to examine any mine

by day or by night, so, however, as not to impede the working thereof; and owners, agents, and managers, and all employed in or about the mine, are bound to render him every assistance in conducting such examination.

7. He is to make to a Secretary of State an annual report of his proceedings, to be laid before Parliament, and, when directed, is to make a special report as to any mine accident attended with loss of life or personal injury. Such special report will be made public in the mode, and at the time directed by a Secretary of State.

8. *Rule.*—Subject to the exceptions mentioned below, every mine must be under the control and daily supervision of a certificated manager.

9. *Exception* 1.—The rule requiring a manager does not apply to any mine in which less than 30 persons are ordinarily employed below ground, unless the inspector of the district insists upon it.

10. *Exception* 2.—The rule requiring a manager does not apply to any mine, the average daily output of which does not exceed 25 tons, unless the inspector of the district insists upon it.

11. *Exception* 3.—In special circumstances, notified to the inspector of the district, a manager may be temporarily dispensed with.

12. The certificate, given by a Secretary of State, is either a certificate of service, given only to persons who, before the 10th of August, 1872, were acting, and have since then acted, in the capacity of manager of mine, or who, since the 10th of August, 1867, have acted in a like capacity for more than twelve months; or a certificate of competency, given after examination, and upon proof of sobriety, experience, ability and general good conduct. The examination is conducted by examiners appointed by a district board, and the members of such district board are appointed by the Secretary of State, and consist of three owners, agents, or managers of a mine within the district; three persons employed in or about a mine within the district, not being owners, agents, or managers; three mining engineers, agents, managers, or coal-viewers within the district, and an inspector of mines. The area of the district is fixed by a Secretary of State.

13. The owner or agent may nominate either himself or any other person as manager, but the manager must not be a contractor for getting the mineral, or in the employ of a contractor.

14. A Secretary of State, on a representation made that a certificated manager is, by reason of incompetency or gross negligence, unfit to discharge his duties, or has been convicted for an offense against the Act may order a court of inquiry to be held, and, on the report of the court, cancel or suspend the certificate. He may also restore a certificate canceled or suspended.

15. A register of certificated managers is kept under the directions of a Secretary of State.

16. Women, and girls of any age, may not be employed at all.

17. Boys under 12 may not be employed at all, unless the mine is specially exempted by the Secretary of State by reason of the thinness of the seam, when, subject to certain conditions stated in the exemption, boys between 10 and 12 may be employed.

18. Boys of 12 and under 13, and male young persons of 13 and under 16 may be employed not more than 54 hours a week, or more than 10 hours a day, and are to be allowed an interval of 12 hours for rest between each two consecutive periods

of employment, except between Friday and Saturday, when an interval of 8 hours will suffice.

19. A week begins at 12 P.M. on Saturday and ends 12 P.M. the Saturday following.

20. A period of a person's employment begins at the time of his leaving the surface, and ends at the time of his returning to the surface.

21. The immediate employer of any boy of 12 and under 13, and of any male young person of 13 and under 16, is not to take him below ground until he has reported his intention so to do to the manager, or to some person appointed by the manager.

22. Children under 10, of either sex, may not be employed at all.

23. Children of 10, and under 13, of either sex, may be employed, but not for more than 6 days a week, and for not more than 6 hours a day, if employed for more than 3 days in a week, and not for more than 10 hours a day, if employed for only 3 days, or less than 3 days, in a week.

24. For children so employed an interval of 12 hours for rest must be allowed between two consecutive periods of employment, except between Friday and Saturday, when an interval of 8 hours will suffice.

25. *Schooling.*—The parent or guardian of, or person having the custody or control of any child so employed must see that the child attend school (except in the case of there being no school which the child can attend, within two miles of his or her home, or of the mine). Such attendance must be for at least 20 hours in every 2 consecutive weeks of employment, and any attendance is not to count if it is in excess of 3 hours at a time, or 5 hours in a day, or of 12 hours in a week, or on Sundays, or before 8 A. M., or after 6 P. M.

26. It will be the duty of the immediate employer, after employing a child for a fortnight, to obtain from the teacher every Monday morning during the continuance of the employment a certificate of the child's attendance at the school during the preceding week, and to deliver the certificate to the owner, agent, or manager, who must keep the same in the office at the mine for six months for production to the inspector.

27. Also the person who pays the child's wages must, after a single application of the teacher, pay regularly every week the cost of the child's schooling (not exceeding 2d. a week, or one-twelfth of the child's wages), and he may deduct from the child's wages any sum so paid.

28. A teacher who is unfit, or who misconducts himself, is liable to be disqualified, by an inspector of mines for granting certificates of attendance, subject to an appeal to the Education Department.

29. *Young persons of* 13 *and under* 16, *of either sex, and women above* 13, may not be employed more than 54 hours a week, or more than ten hours a day, and must be allowed an interval of 12 hours for rest between two consecutive periods of employment, except between Friday and Saturday, when an interval of 8 hours will suffice.

30. *Children of* 10 *and under* 13, *of either sex, young persons of* 13 *and under* 16, *of either sex, and women above* 13, may not be employed between 9 P. M. and 5 A. M., or on Sundays, or after 2 P. M. on Saturday: also, they are to be allowed intervals for meals, namely: half an hour during a period of employment which exceeds 5 hours; one and a-half hours during a period of employment which exceeds 8 hours. A

mine in Ireland may be exempted, by the Secretary of State, from the provision as to the Saturday half-holiday. (*See exemption set forth below, paragraph* 72.)

31. The person who is in charge of any engine, windlass, or gin, howsoever worked, which is used for the purpose of taking persons up or down or along any shaft, inclined plane or level, (being either an entrance to a mine or a communication from one part of a mine to another,) or who is in charge of any part of the tackle of such engine, windlass, or gin, must be a male at least 18 years of age. If the engine, windlass, or gin, is worked by an animal, then, not the driver, but the person under whose direction the driver acts, is to be deemed the person in charge; but in that case the driver must not be under 12 years of age.

32. Any parent or guardian misrepresenting the age of any person, with a view to procuring him employment in contravention of the Act, will be liable to punishment.

33. *Not to be Paid in Public House, etc.*—Wages are not to be paid on any premises used for the sale of intoxicating liquor, or in any place contiguous to such premises.

34. Payment by day on yardage is allowed, but in any mine, unless expressly exempted, (see below, paragraph No. 73), where the amount of wages depends on the amount of mineral gotten, wages are to be paid according to the standard weight in pounds avoirdupois of the mineral gotten.

35. The weighing-machines and weights are subject to the inspection of the Inspector of Weights and Measures.

36. *Check-weigher.*—The persons employed in a mine may, if they think proper, appoint a Check-weigher at their own cost. The Check-weigher must be a person employed either in the same mine, or in another mine belonging to the same owner. He is entitled to have every facility afforded to him to take a correct account of the weighing, but he is not to impede the working of the mine, or interfere with the weighing; and in his absence, the weighing may be carried on without him. He is liable to be removed by the magistrates for misconduct, and in that case another may be selected to fill his place.

37. The weighing provisions expressly sanction agreements to be made between employers and employed for deductions on account of "dirt" or "shorts," the words of the act being, "Nothing herein contained shall preclude the owner, agent or manager of the mine from agreeing with persons employed in such mine, that deductions shall be made in respect of stones or materials other than mineral contracted to be gotten, which shall be sent up from the mine with the mineral contracted to be gotten; or in respect of any tubs, baskets, or hutches being improperly filled, in those cases which they are filled by the getter of the mineral, or his drawer, or by a person immediately employed by him." Such deductions are to be determined by the Banks-man, or Weigher and Check-weigher, or, in the event of difference, by a third person, to be mutually agreed on between the owner, agent, or manager, on one hand, and the persons employed in the mine, on the other.

38. *Rule.*—Subject to the exceptions stated below, and to any exemptions specially granted, every mine must have two shafts or outlets in communication with every seam in work, which are capable of affording distinct means of ingress and egress to the persons employed in the seam. These shafts need not belong to the same mine. They must be separated by natural strata of not less than 10 feet in breadth, though openings may be made through the strata for such purposes as ventilation and

drainage. Such openings, however, must, in the case of mines where imflammable gas has been found within the preceding 12 months, be only temporary. Between the two shafts or outlets there must be a communication not less than 4 feet wide and 3 feet high. At each of the shafts or outlets, or on the works belonging to the mine, there must be kept, for raising or lowering persons, proper apparatus in actual use, or available for use within a reasonable time.

39. *Exception No.* 1.—The rule does not apply in case of a new mine being opened for the purpose of searching for or proving minerals, so long as not more than 20 persons are employed below ground at any one time in the whole of the different seams in connection with the shaft.

40. *Exception No.* 2.—The rule does not apply to any working for the purpose of making communication between two or more shafts, so long as not more than 20 persons are employed below ground at any one time in the whole of the different seams in connection with each shaft or outlet.

41. *Exception No.* 3.—The rule does not, in the case of mines which, before the passing of the act, were not required to have a double shaft, come into operation till the first of January, 1875.

42. In certain cases temporary or permanent exemptions are allowed. (See below, paragraph 74).

43. Where any mine is abandoned, or the working thereof discontinued (at whatever time such abandonment or discontinuance occurred), the top of the shaft and any side entrance from the surface must be kept securely fenced by the owner of the mine or the persons interested in the minerals thereof.

44. The Act prescribes general rules (*set forth at length hereunder, paragraph* 70), which are to be observed, so far as is reasonably practicable, in every mine.

45. In addition to the general rules, but not at variance with them, each mine must have its own set of special rules, framed to meet the special circumstances of the mine.

46. *Object.*—The object of special rules is to prevent dangerous accidents, and to provide for the proper discipline of those employed in the mine.

47. *Force.*—Special rules have the same force as if they were contained in the Act.

48. *How Made.*—Special rules are prepared in the first instance on behalf of the owner, and are, together with a notice, to be posted up during a fortnight on the premises; such notice to be printed, and to be to the effect that, at the end of the fortnight, the rules will be submitted to the inspector of mines for the district, and that, in the meantime, any person employed in the mine is entitled to forward any objection to the inspector at his address as stated in the notice. On the expiration of the fortnight they are to be signed by the owner, agent or manager, and transmitted to the inspector, together with a certificate that the rules and the notice have been posted up as aforesaid.

49. A Secretary of State may, within 40 days, object to the special rules if they are insufficient or unreasonable, and require them to be modified. These requisitions must be complied with, or else referred to arbitration.

50. After 40 days special rules, if not objected to, become established, and are to be signed by the inspector of the district.

51. *At what time to be made.*—In mines having special rules in operation on 1st

January, 1873, proper steps must be taken before 1st April, 1873, to submit a new set of special rules to the inspector. Meantime, the existing special rules will continue in force. In the case of a new mine being opened, or the working of an old mine being renewed, the Act allows three months within which special rules may be submitted.

52. *Amendment.*—At any time special rules may be amended in like manner at the instance of the owner, agent, or manager. Also, the Secretary of State may at any time propose amendments, which must be complied with, or referred to arbitration.

53. *Publication.*—A copy at full length of the special rules when made, and also of this abstract, together with the name and address of the inspector of the district, and the name and address of the owner, or agent, or manager of the mine must be kept posted up on the premises, and a copy thereof supplied gratis on application.

54. Any person who pulls down documents so posted up is liable to punishment.

55. If in any respect a mine is carried on in a manner which, though not expressly forbidden by the terms of the Act, or by special rules, is, nevertheless, dangerous, the inspector may require the matter to be remedied, and the owner, agent, or manager, is bound to comply with the requisition, or else submit to a reference to arbitration.

56. Breach of a general rule by any person, or of a special rule by any person bound to observe the same, is an offence against the Act. And in the event of such an offence being proved to have been committed, the owner, agent, and manager will also each of them be guilty of an offence against the Act, unless he proves that he had taken all reasonable means to prevent the offence by publishing, and, to the best of his knowledge, enforcing rules. A like liability arises with respect to other provisions of the Act, the breach of which is declared an offence against the Act.

57. The penalty for an offense against the Act, (except when another penalty is expressly specified) is, if the offense be committed by a person employed in or about the mine, not exceeding £2; if committed by the owner, agent or manager, not exceeding £20, and a further penalty not exceeding £1 per day for every day that such offense continues to be committed, after a written notice from the inspector.

58. Where, however, the court is of the opinion that the offense is one which is reasonably calculated to endanger the safety of those employed in or about the mine, or to cause serious personal injury or dangerous accident, and was committed willfully by the personal act, personal default, or personal negligence of the accused, and that pecuniary penalty will not meet the circumstances of the case, the punishment may be imprisonment, with or without hard labor, for three months.

59. An appeal lies in case of imprisonment, or half the maximum penalty has been adjudged.

60. An offense can only be prosecuted within three months after the date when it is committed.

61. An offense by an owner, agent, or manager cannot be summarily prosecuted, except either by an inspector of mines or with the consent of the Secretary of State.

62. The owner, agent, or manager may be sworn and examined as an ordinary witness, if charged in respect of any contravention or non-compliance by another person.

63. Penalties for neglecting to send notice of accident, or for any offense against the Act which has occasioned loss of life or personal injury, may be directed by a Secretary of State to be paid to the sufferers, or to relatives of deceased sufferers, but not to any person who has contributed to the neglect or offense.

64. A person who is the owner, agent, or manager of any mine in which the Coal Mines Regulation Act applies, or the father, son, or brother of such owner, agent, or manager, is disqualified from summarily adjudicating on any offense committed against the Act.

65. *Register.*—The owner, agent, or manager must keep in the office at the mine, a register containing particulars prescribed by section 13, as to all persons whose hours of employment are regulated by the Act; and, also, a memorandum of the certificates of school attendance. The register is to be produced to the inspector, who may inspect or copy it.

66. Returns are to be sent, annually, by the owner, agent, or manager of each mine to the inspector of the district, namely: on January 1st a return in the form of Schedule 4 to the Act, and on or before February 1st a return, in form to be prescribed by a Secretary of State, specifying the particulars mentioned in section 38 of the Act.

67. *Plans.*—The owner, agent, or manager is to keep in the office, at the mine, an accurate plan and section, or a tracing thereof, showing the workings up to at least six months previously, and is to produce it to the inspector of mines to examine, but not to copy; and, if requested, is to mark on the plan the workings up to production.

68. *Plans and Abandonment.*—Within three months of the abandonment of a mine, a plan and section, or tracing thereof, showing the boundaries of the workings, are to be sent by the owner to the Secretary of State, as a mining record, not, however, to be seen, until after the lapse of 10 years, except by an inspector, or by consent.

69. Notices must be sent by the owner, agent, or manager of a mine to the inspector of mines for the district, as follows: Of the appointment of a manager, together with his name and address, immediately after his appointment; and in case of the temporary appointment of an uncertificated manager, the notice shall state the reason for such appointment. Of any accident causing loss of life, or serious personal injury, within 24 hours after such accident. Of any accident from explosion of gas, powder, or steam boiler, causing any personal injury, within 24 hours after such accident. Of any death resulting from personal injury, caused by an accident previously reported, within 24 hours after the death comes to the knowledge of the owner, agent, or manager. The following to be made within two months after the event to be notified: Of the commencement of any working for the opening of a new shaft. Of the abandonment of a shaft. Of the recommencement of the working of a shaft after an abandonment of more than two months. Of any change in the name of the mine, or in the name of the owner, agent, or manager. Of any change in the officers of any incorporated company owning a mine. *Notice* must also be given by the owner or agent (not by the manager), of the fact that two or more parts of a mine are worked separately, with a view that each may be deemed to constitute a separate mine for the purposes of the Act.

70. *Coroners' Inquests.*—In the case of an inquest being held concerning a death caused by a mine accident, unless the inspector or some other person on behalf of a

Secretary of State is present, the coroner is to adjourn the inquest, and to send to the inspector four days' notice of the time and place of the adjourned inquest. If, however, only one life has been lost by the accident, and 48 hours' notice of time and place of holding the inquest has been sent to the inspector, the inquest need not be adjourned if a majority of the jury think it unnecessary. At the inquest the inspector of mines may examine any witness subject to the order of the coroner. If the inspector is not present, and evidence is given of any neglect having caused or contributed to the accident, or of any defect in or about the mine appearing to require a remedy, the coroner is to send to the inspector notice thereof in writing. In the event of fatal accident occurring in a mine and an inquest being held, no person who is employed in that mine, or is concerned in its management, or has a personal interest in that mine, is qualified to serve on the jury.

71. *Employment of Boys in Thin Seam Mines.*—A Secretary of State may exempt a thin seam mine from the provisions (*see above, paragraph No.* 17) prohibiting employment, below ground, of boys under 12. In a mine so exempted, boys of 10 and under 12 may be employed underground, but not for more than 6 days a week; not for more than 6 hours a day, if employed for more than three days in a week; not for more than 10 hours a day, if employed for only 3 days or for less than 3 days in a week. An interval of 12 hours rest shall be allowed between each two consecutive periods of employment, except between Friday and Saturday, when an interval of 8 hours will suffice. The period of each employment of a boy is deemed to begin at the time of his leaving the surface, and to end at the time of his return to the surface. The week is deemed to begin at 12 P. M. Saturday, and to end at 12 P. M. on the Saturday following. The immediate employer of any boy of 10 and under 12 is not to take him below ground until he has reported his intention so to do to the manager, or to some person appointed by the manager. Boys of 10 and under 12 are subject to the same provisions with regard to *schooling* as are prescribed (*see above, paragraphs* 25, 26, 27, 28,) for children under 13 employed above ground.

72. *Saturday Half-Holiday—Ireland.*—A Secretary of State may exempt any mine in Ireland from the provision (*see above, paragraph* 30), prohibiting the employment below ground of women, young persons, or children, after 2 o'clock on Saturday afternoon.

73. *Weighing provisions.*—A Secretary of State may grant exemption from the weighing provisions (see above, paragraph 34), or postpone their operation with respect to any mine or class of mines, as to which he is satisfied that such exemption or postponement is requisite or expedient by reason of the exigencies of the case. In any mine so exempted, wages may be paid according to measure or gauge, and local measures and gauges may be adopted, subject, however, to inspection by the Inspectors of Weights and Measures. A Check-measurer may be appointed in like manner as a Check-weigher.

74. *Single shafts.* A Secretary of State may exempt a proved mine from the provisions (see above, paragraph 42), prohibiting single shafts if satisfied that the quantity of mineral proved is insufficient to repay the outlay of the sinking or making of a second shaft or outlet. In a mine so exempted, there must not be employed below ground, at any one time in the whole of the different seams in connection with the shaft or outlet, more than 20 persons; or, if the mine is not a coal mine, or mine with inflammable gas, more than such other larger number as a Secretary of State may allow. If the mine is not a coal mine, or mine with inflammable gas, and

the Secretary of State is satisfied that sufficient provision has been made against danger from other cause than explosion of gas by using stone, brick, or iron, in the place of wood, in the lining of the shaft and construction of the mid-wall; in a mine so exempted, there must not be employed below ground, at any one time, in the whole of the different seams in connection with the shaft or outlet, more than the number of persons the Secretary of State may allow. If satisfied that the workings of a seam have reached the boundafy of the property, or the extremity of the mineral field, and that it is expedient to work away the pillars already formed in the course of the ordinary workings, notwithstanding that by so working away the pillars one of the shafts or outlets may be cut off. In a mine so exempted, there must not be employed below ground, at any one time, in the whole of the different seams in connection with the shaft or outlet, more than 20 persons; or, if the mine is not a coal mine, or a mine with inflammable gas, more than such larger number as the Secretary of State may allow, if satisfied, by reason of an accident, one of the shafts or outlets has become unavailable for the use of the persons employed in the mine; a mine so exempted may only be worked subject to the conditions specified in the exemption. In the case of a mine, not at the time of the passing of the act, required to have two outlets, provided that an application is made in England or Scotland within six months after the first of January, 1873, or in Ireland within six months after the first of January, 1874, and the Secretary of State is satisfied that the mine is nearly exhausted; if the Secretary of State refuse to grant such exemption, the matter may be referred to arbitration.

75. Also, in the case of a mine not at the time of the passing of the Act required to have two outlets, a Secretary of State may grant an extension of time (see above, paragraph 41) for providing an additional shaft or outlet, if an application is made to him within six months preceding the 1st of January, 1875. In the event of the Secretary of State refusing such extension of time, the matter may be referred to arbitration.

76. The following are the general rules: An adequate amount of ventilation shall be constantly produced in every mine to dilute and render harmless noxious gases to such an extent that the working places of the shafts, levels, stables, and workings of such mine, and the traveling roads to and from such working places shall be in a fit state for working and passing therein.

In every mine in which inflammable gas has been found within the preceding twelve months, then once in every twenty-four hours if one shift of workmen is employed, and once in every twelve hours if two shifts are employed during any twenty-four hours, a competent person or competent persons, who shall be appointed for the purpose, shall, before the time for commencing work in any part of the mine, inspect with a safety-lamp that part of the mine, and the roadways leading thereto, and shall make a true report of the condition thereof, so far as ventilation is concerned, and a workman shall not go to work in such part until the same and the roadways leading thereto are stated to be safe. Every such report shall be recorded without delay in a book which shall be kept at the mine for the purpose, and shall be signed by the person making the same.

In every mine, in which inflammable gas has not been found within the preceding twelve months, then once in twenty-four hours a competent person or competent persons, who shall be appointed for the purpose, shall, so far as is reasonably practicable immediately before time for commencing work in any part of the mine, inspect that part of the mine, and the roadways leading thereto, and shall make a true report of the condition thereof so far as ventilation is concerned, and a workman shall not go to work in such part until the same and the roadways leading thereto are stated to be safe. Every such report shall be recorded without delay in a book which shall be kept at the mine for the purpose, and shall be signed by the person making the same.

All entrances to any place not in actual course of working and extension shall be properly fenced across the whole width of such entrance, so as to prevent persons inadvertently entering the same.

A station or stations shall be appointed at the entrance to the mine, or to different parts of the mine, as the case may require, and a workman shall not pass beyond any such station until the mine or part of the mine beyond the same has been inspected and stated to be safe.

If, at any time, it is found by the person for the time being in charge of the mine or any part thereof, that by reason of noxious gases prevailing in such mine or such part thereof, or, of any cause whatever, the mine or the said part is dangerous, every workman shall be withdrawn from the mine or such part thereof as is so found dangerous, and a competent person, who shall be appointed for the purpose, shall inspect the mine or such part thereof as is so found dangerous, and if the danger arises from inflammable gas, shall inspect the same with a locked safety-lamp, and in every case shall make a true report of the condition of such mine or part thereof, and a workman shall not, except in so far as is necessary for inquiring into the cause of danger, or for the removal thereof, or for exploration, be re-admitted into the mine, or such part thereof as was so found dangerous, until the same is stated by such report not to be dangerous. Every such report shall be recorded in a book which shall be kept at the mine for the purpose, and shall be signed by the person making the same.

In every working approaching any place where there is likely to be an accumulation of explosive gas, no lamp or light other than a locked safety-lamp shall be allowed or used; and whenever safety-lamps are required, by the Act or by the special rules made in pursuance of the Act, to be used, a competent person, who shall be appointed for the purpose, shall examine every safety-lamp immediately before it is taken into the workings for use, and ascertain it to be secure and securely locked; and in any part of a mine in which safety-lamps are so required to be used, they shall not be used until they have been so examined and found secure and securely locked, and shall not, without due authority, be unlocked; and in the said part of a mine a person shall not, unless he is appointed for the purpose, have in his possession any key or contrivance for opening the lock of any such safety-lamp, or any lucifer-match or apparatus of any kind for striking a light.

Gunpowder, or other explosive or inflammable substance, shall only be used in the mine underground, as follows: It shall not be stored in the mine. It shall not be taken into the mine, except in a case or canister, containing not more than four pounds. A workman shall not have in use, at one time, in any one place, more than one of such cases or canisters. In charging holes for blasting an iron or steel picker shall not be used, and a person shall not have in his possession, in the mine underground, any iron or steel picker; and an iron or steel tamping rod or stemmer shall not be used for ramming either the wadding or the first part of the tamping or stemming on the powder. A charge of powder which has missed fire shall not be unrammed. It shall not be taken into or be in possession of any person in any mine, except in cartridges, and shall not be used, except in accordance with the following regulations, during three months after any inflammable gas has been found in any such mine, namely: A competent person, who shall be appointed for the purpose, shall, immediately before firing a shot, examine the place where it is to be used, and the places contiguous thereto, and shall not allow the shot to be fired unless he finds it safe to do so; and a shot shall not be fired except by or under the direction of a competent person, who shall be appointed for the purpose. If the said inflammable gas issues so freely that it shows a blue cap on the flame of the safety-lamp, it shall only be used either in those cases of stone-drifts, stone-work, and sinking of shafts, in which the ventilation is so managed that the return air from the place where the powder is used passes into the main air-course without passing any place in actual course of working, or when the persons ordinarily employed in the mine are out of the mine, or out of the part of the mine it is used. Where a mine is divided into separate panels, in such manner that each panel has an independent in-take and return air-way from the main air-course and the main return air-course, the provisions of this rule, with respect to gun-powder, or other explosive inflammable substance, shall apply to each such panel in like manner as if it were a separate mine.

Where a place is likely to contain a dangerous accumulation of water, the working approaching such place shall not exceed eight feet in width. and there shall be constantly kept, at a sufficient distance, not being less than five yards, in advance, at least one bore-hole near the center of the working, and sufficient flank bore-holes on each side.

Every underground plane on which persons travel, which is self-acting or worked by an engine, windlass, or gin, shall be provided (if exceeding thirty yards in length) with some proper means of signalling between the stopping places, and the ends of the plane, and shall be provided in every case, at intervals of not more than twenty yards, with sufficient man-holes for places of refuge.

Every road on which persons travel underground, where the load is drawn by a horse or other animal, shall be provided, at intervals of not more than fifty yards, with sufficient man-holes, or with a space for a place of refuge, which space shall be of sufficient length, an dof at least three feet in width, between the wagons running on the train-road and the side of such road.

Every man-hole, and a space for a place of refuge, shall be constantly kept clear, and no person shall place anything in a man-hole or such space so as to prevent access thereto.

The top of every shaft, which for the time being is out of use, or used only as an air shaft, shall be securely fenced.

The top and all entrances between the top and bottom of every working or pumping shaft shall be properly fenced, but this shall not be taken to forbid the temporary removal of the fence for the purpose of repairs, or other operations, if proper precautions are used.

Where the natural strata are not safe, every working or pumping shaft shall be securely cased, lined, or otherwise made secure.

The roof and sides of every traveling road and working place shall be made secure, and a person shall not, unless appointed for the purpose of exploring or repairing, travel, or work in any such traveling road or working place which is not so made secure.

Where there is a downcast and furnace shaft, and both such shafts are provided with apparatus in use for raising and lowering persons, every person employed in the mine shall, upon giving reasonable notice, have the option of using the downcast shaft.

In any mine which is usually entered by means of machinery, a competent person of such age as prescribed by the Act, shall be appointed for the purpose of working the machinery which is employed in lowering and raising persons therein, and shall attend for the said purpose during the whole time that any person is below ground in the mine.

Every working shaft used for the purpose of drawing minerals or for lowering or raising of persons, shall, if exceeding fifty yards in depth and not exempted in writing by the inspector of the district, be provided with guides and some proper means of communicating distinct and definite signals from the bottom of a shaft and from every entrance for the time being in work, between the surface and the bottom of the shaft to the surface, and from the surface to the bottom of the shaft and to every entrance for the time being in work between the surface and the bottom of the shaft.

A sufficient cover overhead shall be used when lowering or raising persons in every working shaft, except where it is worked by a windlass, or where the person is employed about the pump or some work of repair in the shaft, or where a written exemption is given by the inspector of the district.

A single linked chain shall not be used for lowering or raising persons in any working shaft or plane, except for the short coupling chain attached to the cage or load.

There shall be on the drum of every machine used for lowering or raising persons, such flanges or horns, and also if the drum is conical, such other appliances, as may be sufficient to prevent the rope from slipping.

There shall be attached to every machine worked by steam, water, or mechanical power, and used for lowering or raising persons, an adequate brake, and also a proper indicator (in addition to any mark on the rope) which shows to the person who works the machine the position of the cage or load in the shaft.

Every fly-wheel and all exposed and dangerous parts of the machinery used in or about the mine shall be and be kept securely fenced.

Every steam boiler shall be provided with a proper steam gauge and water gauge, to show respectively the pressure of steam and the height of water in the boiler, and with a proper safety valve.

After dangerous gas has been found in any mine, a barometer and thermometer shall be placed above ground in a conspicuous position near the entrance to the mine.

No person shall willfully damage, or without proper authority remove or render useless, any fence, fencing, casing, lining, guide, means of signalling, signal, cover, chain, flange, horn, break, indicator, steam gauge, water gauge, safety valve, or other appliance or thing provided in any mine, in compliance with the Act.

Every person shall observe such directions with respect to working as may be given to him with a view to comply with the act or the special rules.

A competent person or competent persons who shall be appointed for the purpose shall, once at least in every twenty-four hours, examine the state of the external parts of the machinery, and the state of the head-gear, working places, levels, planes, ropes, chains, and other works of the mine which are in actual use, and once at least in every week shall examine the state of the shafts by which persons ascend or descend, and the guides or conductors therein, and shall make a true report of the result of such examination, and such report shall be recorded in a book to be kept at the mine for the purpose, and shall be signed by the person who made the same.

The persons employed in a mine may from time to time appoint two of their number to inspect the mine at their own cost, and the persons so appointed shall be allowed, once at least in every month, accompanied, if the owner, agent, or manager of the mine thinks fit, by himself or one or more officers of the mine, to go to every part of the mine, and to inspect the shafts, levels, planes, working places, return airways, ventilating apparatus, old workings, and machinery, and shall be afforded by the owner, agent, and manager, and all persons in the mine, every facility for the purpose of such inspection, and shall make a true report of the result of such inspection, and such report shall be recorded in a book to be kept at the mine for the purpose, and shall be signed by the persons who made the same.

The books mentioned in the General Rules, or a copy thereof, shall be kept at the office of the mine, and any inspector under the Act, and any person employed in the mine, may, at all reasonable times, inspect and take copies of and extracts from any such books.

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May 14, 1881. The following now forms the law of the State, as will be seen by reference to the old law. A number of important amendments were made during the late session of the General Assembly:

NEW OHIO MINING LAW AS REVISED AND AMENDED.

SECTION 290. The inspector of mines shall be appointed by the governor, by and with the advice and consent of the senate, and shall hold his office for four years; and no person shall be appointed unless he is possessed of a competent knowledge of chemistry, geology, and mineralogy, and has a practical knowledge of mining engineering, and of the different systems of working and ventilating coal mines, and of the nature and properties of the noxious and poisonous gases of mines, particularly fire-damp.

SEC. 291. Before entering upon the discharge of the duties of the office, the inspector shall give bond to the state in the sum of five thousand dollars, with sureties, to be approved by the governor, conditioned for the faithful performance of his duties; the bond, with his oath of office, and approval of the governor indorsed thereon, shall be forthwith deposited with the secretary of state.

SEC. 292. The inspector shall give his whole time and attention to the duties of his office, and shall examine all the mines in the state as often as his other duties will permit, to see that the provisions of this chapter are obeyed ; and the inspector may enter, inspect, and examine any mine in the state, and the works and machinery belonging thereto, at all reasonable times, by night or by day, but so as not to unnecessarily obstruct or impede the working of the mine, and to make inquiry into the state and condition of the mine, as to ventilation and general security; and the owner and agent of such mine are hereby required to furnish the means necessary for such entry and inspection, of which inspection the inspector shall make a record, noting the time and all the material circumstances; and the person having charge of any mine, whenever loss of life occurs by accident connected with the working of such mine, or by explosion, shall give notice forthwith, by mail or otherwise, to the inspector of mines, and to the coroner of the county in which such mine is situated, who shall hold an inquest upon the body of the person or persons whose death has been caused, and inquire carefully into the cause thereof, and shall return a copy of the finding and all the testimony to the inspector.

SEC. 293. The inspector, while in office, shall not act as an agent, or as a manager, or mining engineer, or be interested in operating any mine ; and he shall annually make report to the governor of his proceedings and the condition and operation of the mines of the state, enumerating all accidents in or about the same, and giving all such other information as he thinks useful and proper, and making such suggestions as he deems important as to further legislation on the subject of mining.

SEC. 294. The inspector shall have an office in the state house, in which shall be carefully kept the maps and plans of all mines in the state, and all records and correspondence, papers, and apparatus, and property pertaining to his duties, belonging to the state, and which shall be handed over to his successor in office.

SEC. 295. There shall be provided for the inspector all instruments and chemical tests necessary for the discharge of his duties under this chapter, which shall be paid for on the certificate of the inspector, and which shall belong to the state.

SEC. 296. The owner or agent of every coal mine, shall make, or cause to be made, an accurate map or plan of the working of such mine, on a scale of not less than one hundred feet to the inch, showing the area mined or excavated, and the location and connection with such excavation of the mine of the lines of all adjoining lands, and the name or names of each owner or owners, so far as known, marked on each tract, a true copy of which map the owner or agent shall deposit with the inspector, and another copy of which shall be kept at the office of such mine; and the owner or agent shall, every four months thereafter, file with the inspector a statement and plan of the workings of such mine up to that date, which statement and plan shall be so prepared as to enable the inspector to mark the same on the original map or plan herein required to be made; and in case of refusal on the part of the owner or agent to make and file the map or plan, or the addition thereto, the inspector is authorized to cause an accurate map or plan of the whole of said mine to be made, at the expense of the owner thereof, the cost of which shall be recoverable against the owner, in the name of the person or persons making the map or plan, which shall be made in duplicate, one copy being delivered to the inspector and the other left in the office of the mine; and he shall, on being paid the proper cost thereof, on demand of any person interested in the working of such mine, or owner of adjoining lands, furnish an accurate copy of any map or plan of the working of such mine.

SEC. 297. It is unlawful for the owner or agent of any coal mine worked by a shaft, wherein over fifteen thousand square yards have been excavated, to employ or permit any person to work therein, unless there are, to every seam of coal worked in each mine, at least two separate outlets, separated by natural strata of not less than one hundred feet in breadth, by which shafts or outlets distinct means of ingress and egress are always available to the persons employed in the mine; but it is not necessary for the two outlets to belong to the same mine; the second outlet need not be made until fifteen thousand yards have been excavated in such mine; and to all other coal mines, whether slopes or drifts, two such openings or outlets must be provided within twelve months after fifteen thousand yards have been excavated therein; and in case such outlets are not provided as herein stipulated, it shall not be lawful for agent or owner of such mine to permit more than ten persons to work therein at any one time. In case a coal mine has but one shaft, slope, or drift, for the ingress or egress of the men working therein, and the owner thereof does not own suitable surface-ground for another opening, he may select and appropriate any adjoining land for that purpose and for approach thereto, and shall be governed in his proceeding in appropriating such land by the provisions of law in force providing for the appropriation of private property by corporations, and such appropriations may be made, whether he is a corporator or not; but no land shall be appropriated under the provisions of this chapter until the court is satisfied that suitable premises can not be obtained by contract upon reasonable terms.

SEC. 298. The owner or agent of every coal mine, whether shaft, slope, or drift, shall provide and maintain for every such mine, an amount of ventilation of not less than 100 cubic feet, per minute, per person employed in such mine, which shall be circulated and distributed throughout the mine in such a manner as to dilute, render harmless, and expel the poisonous and noxious gases from each and every working-place in the mine, and no working-place shall be driven more than 120 feet in advance of a break-through, or air-way; and all break-throughs, or air-ways, except those last made near the working-faces of the mine, shall be closed up and made air-tight, by brattice, trap-doors, or otherwise, so that the currents of air in circulation in the mine may sweep to the interior of the mine, where the persons employed in such mine are at work, and all mines governed by the statutes shall be provided with artificial means of producing ventilation, such as forcing, or suction fans, exhaust steam, furnaces, or other contrivances, of such capacity and power, as to produce and maintain an abundant supply of air, and all mines generating fire-damp shall be kept free from standing gas, and every working-place shall be carefully examined, every morning, with a safety-lamp, by a competent person, or persons, before any of the workmen are allowed to enter the mine.

SEC. 299. The owner or agent of every coal mine operated by shaft, in all cases where human voice can not be distinctly heard, shall, forthwith, provide and maintain a metal tube from the top to the bottom of such shaft, suitably calculated for the free passage of sound therein, so that conversations may be held between persons at the bottom and top of the shaft; and there shall also be provided an approved safety-catch, and a sufficient cover overhead, on all carriages used for lowering and hoisting persons, and in the top of every shaft an improved safety-gate, and an adequate brake shall be attached to every drum or machine used for lowering or raising persons in all shafts or slopes.

SEC. 300. No owner or agent of any coal mine operated by a shaft or slope shall place in charge of any engine used for lowering into or hoisting out of such mine persons employed therein, any but experienced, competent, and sober engineers; and no engineer in charge of such engine shall allow any person, except such as may be deputed for that purpose, by the owner or agent, to interfere with it or any part of the machinery, and no person shall interfere or in any way intimidate the engineer in the discharge of his duties; and in no case shall more than ten men ride on any cage or car at one time, and no person shall ride upon a loaded cage or car in any shaft or slope.

SEC. 301. All safety-lamps used for examining coal mines, or which are used in any coal mine, shall be the property of the owner of the mine, and shall be under the charge of the agent thereof, and in all mines, whether they generate fire-damp or not, the doors used in assisting or directing the ventilation of the mine, shall be so hung and adjusted that they will shut of their own accord and can not stand open, and the mining boss shall keep a careful watch over the ventilating apparatus and the airways, and he shall measure the ventilation at least once a week, at the inlet and outlet, and also at or near the face of all the entries, and the measurements of air so made shall be noted on blanks, furnished by the mine inspector; and on the first day of each month, the mining boss of each mine shall sign one of such blanks, properly filled, with the said actual measurements and forward the same to the mine inspector.

SEC. 302. No boy under twelve years of age shall be allowed to work in any mine, nor any minor between the ages of twelve and sixteen years, unless he can read and write, and in all cases of minors applying for work, the agent of such mine shall see that the provisions of this section are not violated.

SEC. 303. In case any coal mine does not, in appliances for the safety of the persons working therein, conform to the provisions of this chapter, or the owner or agent disregards the requirements of this chapter, any court of competent jurisdiction may, on application of the inspector, by civil action in the name of the state, enjoin or restrain the owner or agent from working or operating such mine, with more than ten miners at once, until it is made to conform to the provisions of this chapter; and such remedy shall be cumulative, and shall not take the place of or affect any other proceedings against such owner or agent authorized by law for the matter complained of in such action.

SEC. 304. When written charges of gross neglect of duty or malfeasance in office against any inspector is made and filed with the governor, signed by not less than fifteen coal miners, or one or more operators of mines, together with a bond in the sum of five hundred dollars, payable to the state, and signed by two or more responsible free-holders, and conditioned for the payment of all costs and expenses arising from the investigation of such charges, the governor shall convene a board of examiners, to consist of two practical coal miners, one chemist, one mining engineer, and one operator, at such time and place as he deems best, giving ten days' notice to the inspector or against whom the charges are made, and also to the person whose name appears first in the charges, and the board, when so convened, and having been first duly sworn, truly to try and decide the charges made, shall summon any witnesses so desired by either party, and examine them on oath, which may be administered by any member of the board, and depositions may be read on such examination, as in other cases; and the board shall examine fully into the truth of such charges, and report the result of their investigation to the governor; and the board shall award the costs and expenses of such investigation against the inspector or the persons signing the bond according to their finding, against said inspector or in his favor, which costs and expenses shall include the compensation of such board, of five dollars per day for each member, for the time occupied in the trial, and in traveling from and to their homes; and the attorney-general shall forthwith proceed to collect such costs and expenses, and pay the same into the state treasury, being in the first instance paid out of the state treasury, on the certificate of the president of such board.

SEC. 305. In all coal mines in the state, the miners employed and working therein, the owners of the land or other persons interested in the rental or royalty of any such mine, shall at all proper times have full right of access and examination of all scales, machinery or apparatus used in or about such mine to determine the quantity of coal mined, for the purpose of testing the accuracy and correctness of all such scales, machinery or apparatus; and such miners, landowners, or other persons, may designate or appoint a competent person to act for them, who shall at all proper times have full right of access and examination of such scales, machinery or apparatus, and seeing all weights and measures of coal mined, and the accounts kept of the same; but not more than one person on behalf of the miners collectively, or one person on behalf of the landowners or other persons interested in the rental or royalty jointly, shall have such right of access, examination and inspection of scales, weights, measures and accounts at the same time, and that such persons shall make no unnecessary interference with the use of such scales, machinery or apparatus; and the miners employed in any mine may, from time to time, appoint two of their number to act as a committee to inspect not oftener than once in every month, the mine and the machinery connected therewrth, and to measure the ventilating current, and if the owner, agent, or manager so desires, he may accompany said committee by himself or two or more persons which he may appoint for that purpose; the owner, agent or manager shall afford every necessary facility for making such inspection and measurement, but the committee shall not in any way interrupt or impede the work going on in the mine at the time of such inspection and measurement, and said committee shall, within ten days after such inspection and measurement, make a correct report thereof to the inspector of mines, on blanks to be furnished by said inspector for that purpose; and if such committee make to the inspector a false or untrue report of the mines, such act shall constitute a violation of this section.

SEC. 306. The provisions of this chapter shall not apply to or affect any coal mine in which not more than ten men are employed at the same time; but on the application of the proprietor of or miners in any such mine, the inspector shall make, or cause to be made, an inspection of such mine, and shall direct and enforce any regulations in accordance with the provisions of this chapter that he deems necessary for the safety of the health and lives of miners.

SEC. 306 (*a*). The inspector of mines may, with the approval of the governor, appoint an assistant, who shall be a practical miner of not less than five years' experience, and who shall perform such duties as may be required by the inspector, and receive a salary at the rate of twelve hundred dollars ($1,200.00) per annum, and the inspector may, with the consent of the governor, remove such assistant at pleasure and appoint a successor, and may allow the assistant traveling expenses out of his contingent fund.

SEC. 6871. Whoever knowingly violates any of the provisions of sections two hundred and ninety-eight, two hundred and ninety-nine, three hundred, three hundred and one, three hundred and two, and three hundred and five, of the revised statutes, or does any act whereby the lives or health of the persons or the security of any mine and machinery are endangered, or any miner or other person employed in any mine governed by the statute, who intentionally and willfully neglects or refuses to securely prop the roof of any working place under his control, or neglects or refuses to obey any order given by the superintendent of a mine in relation to the security of the mine in the part thereof where he is at work, and for fifteen feet back from the face of his working place, shall be fined not more than fifty dollars or imprisoned in the county jail not more than thirty days, or both.

FINANCIAL STATEMENT.

Statement of Traveling and Contingent Expenses from February 15 to November 15, 1880.

Date.	On what account.	Amount.
March 15.	To care of office	$5 00
Feb. 15 to Mar. 15.	visiting mines at Corning, in Perry Co.; also, Straitsville and Stark Co., at North Lawrence	46 30
March 26.	purchasing anometer for measuring the air of mines	40 00
April 2.	purchasing order book (Comly & Francisco)	3 00
	care of office	3 90
	purchasing stamps (A. D. Rogers, P. M.)	10 00
Mar. 15 to Apr. 28.	visiting mines in Jackson Co.; visiting mines at Coshocton, Coshocton Co.; State Line mines, in Columbiana Co; Salineville mines, in Columbiana Co.; New Castle mines in Lawrence Co.; Rainy's mines, in Belmont Co	75 85
May 6.	care of office	5 00
Apr. 28 to May 26.	visiting mines in Meigs Co	41 70
June 1.	care of office	5 00
June 22.	postage stamps (A. D. Rogers, P. M.)	5 00
May 26 to June 23.	visiting Mahoning Valley mines, Sunday Creek Valley mines, and Zaleski mines, in Vinton Co	66 40
July 2.	care of office (H. S. Falor)	7 00
July 7.	postage stamps (A. D. Rogers, P. M.)	10 00
July 13.	looking-glass for office	75
June 23 to July 19.	visiting Coalton and Cambridge mines	30 40
July 27.	tabulating letter-heads (Cott & Hann)	2 25
August 3.	care of office (H. S. Falor)	5 00
July 27 to Aug. 12.	visiting mines in Mahoning Co. and Hocking Valley	42 50
August 30.	postage stamps (A. D. Rogers, P. M.)	10 00
August 31.	care of office (H. S. Falor)	5 00
August 15 to 31.	visiting mines at Del Roy, in Carroll Co., and Straitsville mines	35 50
	assistance in office (David Tod Roy)	14 00
September 30.	care of office (H. S. Falor)	6 00
Sept. 15 to Sept 30.	visiting mines at Mineral Ridge and Church Hill	23 70
October 1 to 28.	visiting mines in Jackson Co., (Price Bros.), and Lawrence Co	25 75
November 4.	care of office (H. S. Falor)	5 00
November 4 to 12.	visiting Palmyra mines and Halliday mines, in Trumbull Co	35 05
	Total	$365 05

LIST OF FATAL ACCIDENTS.

December 23, 1879. Louis Wise was killed in Longstreth's mines, at Nelsonville, by a fall of slate.

December 29. Samuel Forsythe was killed, in the Consolidated mines, New Straitsville, by a fall of coal.

January 15, 1880. Stephen Kaufley was killed, in Peacock mine, Pomeroy, by a fall of slate.

January 30. Edward Shoenberger was killed, at Wadsworth mines, by a shot which burst through the pillar.

February 3. Thomas Joyce, a hopper-boy, Shawnee valley, fatally injured by falling of cars; was run over.

February 18. Archibald Rupert was killed in the John Henry mines, Austintown, by falling down the shaft.

February 3. Ben. Jackson, Longstreth's old mine, fall of slate.

March 13. Wm. Cost, killed at Kienlien's mine, Martin's Ferry, by a fall of slate.

April 16. Frank Boucher, killed in the Newcastle mines. Hanging Rock, by a bell mound falling from the roof.

May 24. Daniel Nolan, killed at the Holliday mine, Vienna, by a train of empty cars running down slope, the chain not being hitched to the cars.

May 25. Peter Gibson, killed in the Burnet bank, Hubbard, by a fall of roof, while drawing pillars.

June . John Gallegher was killed in the Maple Hill mine, Teegarden; suffocated by gas. He had fired a shot, and went back on it too soon, and was overcome by the gas.

July 20. David Joseph, Buckeye mine. Pomeroy was killed by a fall of slate.

July 8. John Wilcox killed, in Cambria mines, Mineral Ridge; cause not stated.

August —. Charles Neghey, a trapper boy, in the Troy mine, Straitsville, was run over by cars in the mine; lived several weeks; both legs were broken; one was amputated.

August 22. Levi Marris, killed at Brooks mine, Nelsonville. The deceased, a boy, was engaged, with others, pushing a car up grade and riding back. The car collided with a post, and crushed the boy's skull.

August 23. Edward McConahey, Sippo mine, Massillon, was killed by an explosion of powder.

September 2. Henry M. Williams killed, in Upson's mine, Shawnee, by a hanging shot.

September 26. Harrison Massey was killed, in Morgan's mine, Coalton, by a fall of slate.

September 10. Wm. Wilson, Longstreth's mine, Nelsonville; cause not given.

October 7. Nathan Willington was killed, in Price Bros. mine, Coalton, by a fall of slate.

November 12. Samuel Arthur was killed, in the mines of Grove Coal Co., Massillon, while cleaning a ditch, by a fall of stone from the roof.

Total number of fatal accidents, 22.

LIST OF SERIOUS ACCIDENTS.

1879—*December* 4. Henry Johnson, leg smashed in the Plummer Hill mine, New Straitsville.

December 10. Henry Gross, injured by fall of stone while passing along the entry to his work, in the Home Bank, Coshocton.

December 19. John W. Cursh, Yorkville mines, had a leg smashed by a fall of slate.

December 27. Frank McCurty, Cleveland shaft, Trumbull county, badly hurt in back by a fall of slate. McCurty was deaf and dumb.

1880—*January* 15. Stanton Heck and Wm. Norton, hurt at State Line mines, East Palestine, by a fall of slate.

January 28. M. Arnold, Excelsior mine, Pomeroy, fingers shot off by a premature blast.

February 12. Jackob Six, Floodwood mine, leg broken by being run over by a car.

March 2. John Johnson, hurt in Burton's mine, North Lawrence, by a fall of roof; severely injured in back, and leg broken.

March 3. Peter Effler, Peacock mine, crushed by a fall of slate; injuries not stated.

March 10. John Henry, Brookfield mine, Ohio Coal Company, injured by falling off of roof, in back.

March 10. David Morris, Peacock mine, badly crushed by fall of slate.

March 16. Thomas Culberson was thrown off cars in rolling-mill shaft, Steubenville.

March 17. John Strouse, Burton's mine, North Lawrence, severely injured in back and limbs by fall of stone.

March 19. Robert Bell, Massillon mines, had his arm broken by being accidentally struck with a sledge in the hands of his partner.

March —. J. Fannelly, arm broken by being run over by cars, outside, Rainy's mines.

March —. Wm. Newman, Foster mine, Salineville, leg broken by fall of coal.

March —. Vinton Brothers had his foot cut off in Rainy's mine by fall of slate.

April 29. Sam. Griffiths, Smith mines, Shawnee, cut in head by a fall of coal.

May 4. Cesimer Loveng, Union Coal Company's mine, Coshocton, back dislocated by a fall of roof.

May 10. John Morrison, Scrip Hill mine, Youngstown, severely injured by fall of roof.

May 10. Willis Russell, Diamond mine, hurt in head by fall of roof.

May 14. E. P. Lewer, seriously, if not fatally, injured in Rauckenhouser mine, Bellaire, by fall of slate.

May —. Amelia Perne, Mahoning Coal Company mine, back dislocated by fall of roof.

May —. T. C. Evans, hurt in same mine as above, in shoulder and thigh.

May —. G. Wynn, Steubenville Coal & Mining Company.

May —. Peter Youngflush, leg broken by fall of coal, Sippo mine, Massillon.

May 18. August Blank, Church Hill mines; ribs broken and shoulder hurt by a fall of slate.

May 21. John Edwards, Smith mines, Shawnee; fall of coal; hurt in back and hips.

May 27. Stephen Geatches and his two sons (names not stated) were badly hurt by fall of roof, at Mineral Ridge.

June —. John Heatherington, Belmont mines, Bellaire; severely hurt in the head by a fall of roof.

June —. Peter Moylan, badly crushed by fall of coal; Massillon city mine.

June 12. Wm. McKeever, Wellston; fell out of tub while being raised up the shaft. He was one of the sinkers; dangerously hurt on the head.

June 12. John Mosley and his partner, (name not stated), Fosterville mine, badly injured by an explosion of powder.

June 15. Dennis McGee, Wellston; rock fell out of side of shaft. He was a sinker, and was at work at the bottom of the pit, when the rock fell away.

June 15. Jacob Hiney, Massillon; explosion of powder.

July 2. Thomas Griffith, and David Thomas, Brewster Brothers mine, were badly hurt, at the same time, by a blast of powder; Griffith had his arm broken, and was otherwise badly injured, and Thomas lost his eyesight for two weeks, and did not recover from his injuries for three months.

July 15. Harry Seybold, a driver in the Cherry Valley mine, was kicked by a mule so that he was idle four weeks.

July 17. An Italian miner (name not given) severly injured, in Church Hill mines, by a fall of roof; his jaw was broken.

July 18. John O. Williams, Brookfield mine; severely injured by a fall of coal.

August 5. Samuel Hanna, Nelsonville; hurt by a fall of coal; injury not stated.

August 7. Wm. Wallace, Hayden's mines, Haydenville, had his back badly hurt by a fall of coal; will be a cripple for life.

August 7. Rus. Johnson, Hayden mine, Haydenville; ribs broken, and otherwise injured, by a fall of coal.

August 6. Samuel Hanna, Bessemer mines, collar bone and ribs broken; fall of coal.

August —. Charles Ballou, driver in Pendleton's mine, was caught between cars and pillar; injury not stated.

August —. Wm. Harris, Pennel slope, had his arm broken by a fall of coal.

August 14. Joshua Allen, Foster mine, Youngstown; severely injured by being caught between the cage and the cross-timbers at the top of the shaft, while stepping off the cage.

August —. Charles Negley, a trapper boy, Troy mines; both legs run over by cars.

August 18. Frank Griffin, Sunday Creek mines, Perry county; severely injured by explosion of powder.

September 8. Basil Spurrier, old bank, Straitsville, hurt in the head and shoulders by a fall of coal.

September 9. Peter Reedy and Joseph August were hurt in the New York mine, Shawnee, by a fall of coal.

September 19. David Jones, Burnet bank, Hubbard, injured by fall of coal, in bowels and thigh.

September 22. Rudolph Ramark, Willow bank, Massillon, crushed in breast by fall of coal.

September 24. Edwin Hebrew, Halliday mine, Trumbull county, hurt by fall of stone.

October 5. Frank Hodgmen, run over by cars.

October 5. Joseph Treat, shot by a blast from an adjoining room.

October 9. John Robb, Todd & Stambaugh's mine, Akron, back broken by a fall of slate.

October 12. Elias Laughlin, Sippo mine, Massillon, severely injured by premature blast.

November 3. Wm. Cruise, Thomas Iron Company's mine, Gore, leg broken; Burtin's mine, North Lawrence, shoulder fractured by being run over by cars.

November 6. John Parker, Massillon, head cut and otherwise seriously hurt by premature blast.

November 6. Henry Obrect, Massillon City mine, leg broken by fall of coal.

November 8. John Coats, Bessmer mine, had his skull injured, nose and cheek bone broken by fall of coal.

The number of serious accidents are probably not all included in the above list.

LIST OF MINES, ETC.—Continued.

Name of Mine.	Kind.	Name of Operator.	P. O. Address.
Jackson County.			
Star	Shaft.	Star Furnace Co	**Jackson.**
Huron	“	Huron Furnace Co	“
Globe	Slope.	Globe Iron Co	“
Oak Hill F. B. Co.'s	Drift.	David T. Davis	**Oak Hill.**
Tropic	Shaft.	J. C. Jones	**Jackson.**
Price Bros	Drift.	Price Bros	“
Callaghan & Gililand's	“	Callaghan & Gilliland	“
Miller's	“	Miller & Co	“
Kyle	Slope.	Kyle, Shotts & Co	“
Newport	Drift.	James Newport	“
McKitterick's	“	J. J. McKitterick & Co	“
Milton	Shaft.	Milton Furnace and Coal Co	**Wellston.**
Wellston	“	Wellston Coal and Iron Co	“
Wellston, No. 2	“	“ “	“
Morgan's	Drift.	Jones & Morgan	**Coalton.**
Mohler's	“	Scott, Mohler & Co	“
Darling	“	Pimlott & Hall	“
Cannel Bank	“	Cooper & Scott	“
Wilson's	“	J. H. Wilson & Son	“
Patterson's, No. 1	“	Patterson Bros	“
Patterson's, No. 2	“	“	“
Jefferson County.			
R. R. Shaft	Shaft.	Rush Run Coal Co	**Rush Run.**
Lagrange Shaft	“	Lagrange Coal Works Co	**Phillipsburg.**
Walnut Hill	Drift.	Tallman & Harwood	**Yorkville.**
Gravelly Shaft	Shaft.	Cleveland Furnace Co	**Steubenville.**
Stony Hollow	“	Steubenville Coal Mining Co	“
High Shaft	“	“ “	“
Rolling Mill Shaft	“	Spaulding, Woodward & Co	“
Everick's	“	Ohio and Penn. Coal Co.	“
Boreland's	“	Swift Iron and Steel Works Co	“
Diamond	Drift.	S. N & W. G. McCullough	**Linton.**
H. Strip Vein	“	W. H. Wallace & Sons	**Hammondsville.**
Graff	“	W. W. Nessly	**Linton.**
Fire Clay	“	Calumet Terra Cotta Co	**Elliottsville.**
Bustard's	Shaft.	Steubenville Coal & Coke Co	**Steubenville.**
Mingo	“	Junction Iron Co	**Mingo.**
Lawrence County.			
Washington	Drift.	J. A. Turley	**Lampsonville.**
Sheridan Coal Works	“	Sheridan Mining Co	**Sherid'n co'l w'ks.**
Newcastle	“	Means, Kyle & Co	**Hanging Rock.**
Belfont	“	Norton Bros. & Co	**Ironton.**
Lawrence	“	Lawrence Iron Works Co	“
Old Mill Mine	“	N. Y. & Ohio Iron & Steel Co	“
Medina County.			
Diamond	Slope.	Humphrey & Coleman	**Wadsworth.**
Wadsworth	“	Wadsworth Coal Co	“

LIST OF MINES, ETC.—Continued.

Name of Mine.	Kind.	Name of Operator.	P. O. Address.
Meigs County.			
Pomeroy's	Drift.	S. W. Pomeroy	Pomeroy.
Charter Oak	“	“	“
Slope	Slope.	Union Mines Co	Syracuse.
Shaft	Shaft.	Syracuse Coal and Salt Co	“
Riverside	“	Ohio Coal Co	Antiquity.
Williams	Drift.	J. E. Williams	Minersville.
Buckeye	“	Buckeye Salt Co	Pomeroy.
Coal Ridge	“	Coal Ridge Salt Co	“
Crescent City	“	Crescent City Iron Works	“
Big Bend	“	Big Bend Salt Co	“
Diamond	“	Pomeroy Coal Co	“
Dabney	“	“ “	“
Peacock	“	“ “	“
Minersville	“	“ “	“
Mahoning County.			
John Henry	Shaft.		Ohltown.
Austin	“	Tod, Wells & Co	Mineral Ridge.
Cambria	“	W. T. Williams & Co	“
Weathersfield Shaft	“	“ “	“
Foster	“	Foster Coal Co	Youngstown.
Osburn	“	Andrews Bros	“
Darrow's	Drift.	J. P. Darrow	Lowellville.
Powers	Slope.	A. W. Powers	Youngstown.
Enterprise Shaft	Shaft.	Allen Coal Co	“
Kyle's	“	Kyle Coal Co	“
New Slope	Slope.	Osburn Coal Co	Mineral Ridge.
Walter's Bank	Shaft.	Walters & Co	Washingtonville.
Buckeye	“	Robert Hunter	Youngstown.
Pennel	Slope.	New Lisbon Coal Co	“
Harroff	“	Harroff Coal Co	“
Muskingum County.			
Del Carbo	Drift.	Consolidated Coal & Mining Co	Roseville.
Muskingum Valley	“	George Veredrone	“
Horton's	“	Henry Horton	Zanesville.
Wheeler's	“	G. Wheeler	“
Ballou	“	Orrin Ballou	“
Blandy's	“	H. Blandy	“
Stelover's	“	W. A. Stelover	“
Greiner's	“	H. Greiner	“
Harper's	“	E. Harper	“
Peacock	“	D. Mathews & Co	Gilbert Station.
Owens'	“	Jas. Owens	Putnam.
Noble County.			
Macksburg	Drift.	Ohio Coal Co	Macksburg.
Perry County.			
Plummer Hill	Drift.	Straitsville Coal Co	New Straitsville.
Old Mine	“	J. S. Doe & Co	“
Troy Mine	“	Thomas Coal and Iron Co	“